

Liparids from the Eastern sector of Southern Ocean and first information from molecular studies

by

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ABSTRACT. - Two cruises in the eastern sector of the Southern Ocean (POKER 2006 off the Kerguelen Islands and CEAMARC 2008 off Terre Adélie and George V Land), with extensive surveys, provided an interesting and abundant liparid fish collection (two genera, 13 species, 90 specimens). The fish were studied with modern approaches in systematic studies, both from morphoanatomy and molecular sequences (COI Barcode). In addition to providing useful descriptions of species often known from few specimens, the geographical distribution and potential bathymetric and local habitats are more precisely described. From molecular results, including for the first time the sequences from specimens of other areas, the tree hints at the non-monophyly of two genera (*Liparis* and *Careproctus*) and most clades include species from Northern and Southern Hemispheres. The reference dataset will be useful for further studies on this important family from polar seas.

RÉSUMÉ. - Liparidés du secteur oriental de l'océan Austral et premières données tirées des analyses moléculaires.

Deux campagnes réalisées dans le secteur oriental de l'océan Austral (POKER 2006 au large des îles Kerguelen et CEAMARC 2008 au large de la Terre Adélie et de la Terre George V) et couvrant complètement ces zones, ont permis d'obtenir une intéressante et abondante collection de liparidés (deux genres, 13 espèces, 90 spécimens). Les spécimens ont été étudiés avec des approches modernes en systématique, à la fois morpho-anatomiques et à partir de séquences géniques (Barcoding, COI). En dehors de compléments utiles pour la description des espèces, souvent connues d'exemplaires uniques, la distribution géographique et les habitats potentiels bathymétriques et locaux sont précisés. Les arbres résultants des études moléculaires, incluant pour la première fois des spécimens d'origines géographiques différentes, tendent à démontrer, d'une part, la non monophylie de deux genres (*Liparis* et *Careproctus*) et, d'autre part, que la plupart des clades comprennent des espèces des deux hémisphères. Le jeu de données désormais disponible sera utile pour des études ultérieures menées sur cette importante famille bien représentée dans les mers polaires.

Key words. - Liparidae - Southern Ocean - Barcoding - Distribution.

Among the approximately 300 known species of Antarctic fish, only two groups have a high species number: the notothenioids and the liparids. The first are strictly endemic to the Southern Ocean, the second mainly occur in the two Polar Regions, with a high level of endemism in each. In the Southern Ocean, the study of notothenioids is straightforward because the species mostly inhabit the shallower waters and populations are generally large. The situation is different for liparids: they are mainly present in the deep-sea and most often only single specimens are caught. Additionally, our knowledge of the biodiversity of the Southern Ocean is highly patchy. Areas close to the scientific stations are subject to intense (sampling) through oceanographic

cruises (Antarctic Peninsula, subantarctic islands, Weddell Sea, Ross Sea), whereas there is a void in the collection from other large sectors.

The ichthyofauna of the eastern sector of the Southern Ocean is one of the least known. Consequently, taking the opportunity to investigate liparids is a priority. Two recent synoptic cruises, both in the Subantarctic (Kerguelen Plateau, POKER 2006) and the Antarctic (CEAMARC 2008) have allowed gaps to be filled in the knowledge of the geographic and bathymetric distribution and the ecology of liparids. The use of modern approaches in systematic studies (both morphological and molecular) consolidates the previous determinations and improves our understanding

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of the relationships between species.

MATERIAL AND METHODS

Sampling

Two major synoptic cruises were used in the study. The first one was a biomass survey cruise (POKER 2006) on board a chartered fishing vessel (F.V. *Austral*) in the French EZ, off the main subantarctic islands of the Kerguelen Plateau: the Kerguelen Islands. The scientific leader was one of the authors (G.D.).

A total of 209 randomly selected stations was sampled (September-October 2006) on the northern part of the Kerguelen Plateau (shelf and slope, 100 to 1000 m) during POKER 2006 (Fig. 1) with a standardized protocol (duration of the haul: 30 min) of bottom commercial trawling (otter trawl, horizontal opening 20 m, vertical opening 6.5 m, 40 mm mesh size in the codend). All the fish species were sorted and Liparids were deep frozen for laboratory studies.

The second is the Collaborative East Antarctic Marine Census (CEAMARC), conducted during the International Polar Year (IPY, 2008) on board two scientific vessels

(RSV *Aurora Australis* and TS *Umitaka Maru*) along the Eastern Antarctic coast off Terre Adélie and George V Land (see Beaman and O'Brien, 2009).

These two cruises had completely different focus:

- a midwater investigation with both RMT (Rectangular Midwater Trawl) and IYGPT (International Young Gadoid Pelagic Trawl with a 10 mm mesh size in the codend) north of and on the continental shelf with TS *Umitaka Maru*;

- a focus on bottom and demersal sampling using beam trawls (Australian: horizontal opening 3 m, vertical opening 1.39 m, mesh size 10 mm; French: horizontal opening 4 m, vertical opening 0.45 m, mesh size 5 mm), a sled, box corers, grabs and underwater video on a shelf grid and slope transects with RSV *Aurora Australis*.

We examine in this study the fish catches of the 44 IYGPT hauls on 16 stations (at different depths: 15 hauls at 50 m, 15 at 200 m, 10 at 500 m and 7 at 1000 m) of the TS *Umitaka Maru* and of the 83 stations conducted with the two types of beam trawls on the RSV *Aurora Australis* between 163 and 2065 m. The cruise tracks are shown in figure 2. All fish specimens were sorted on board. Rare species (including liparids) were analysed further in the laboratory.

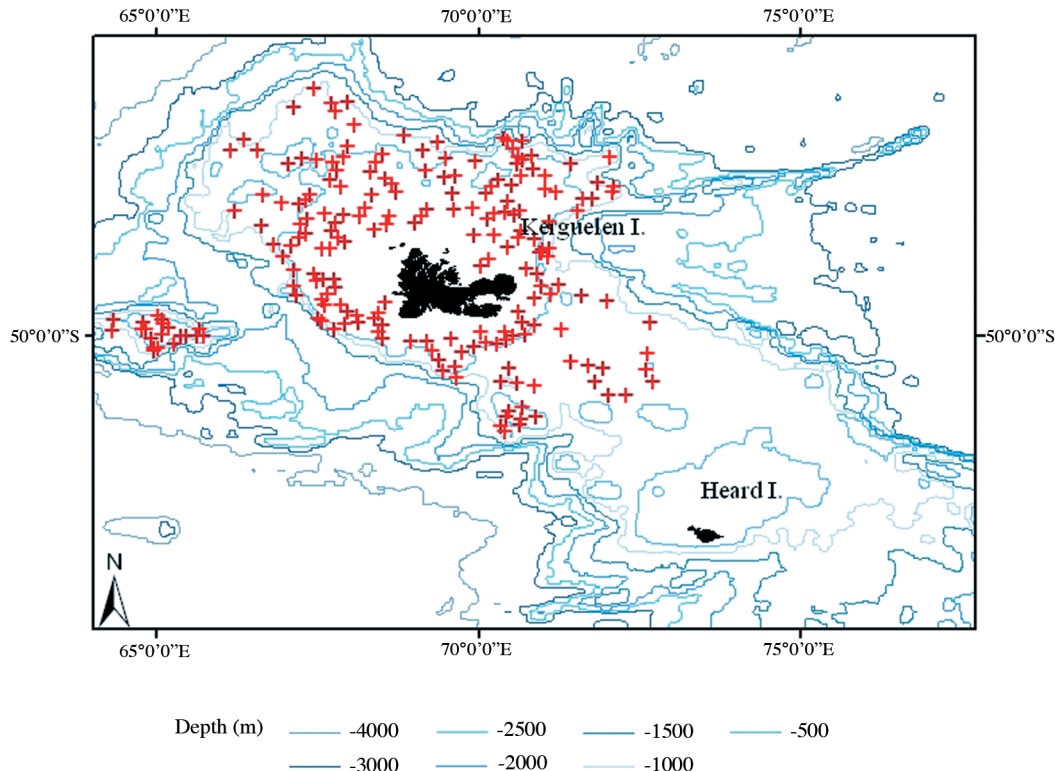


Figure 1. - POKER 2006 bottom trawl (+) stations off the Kerguelen Islands (northern part of the Kerguelen Plateau).

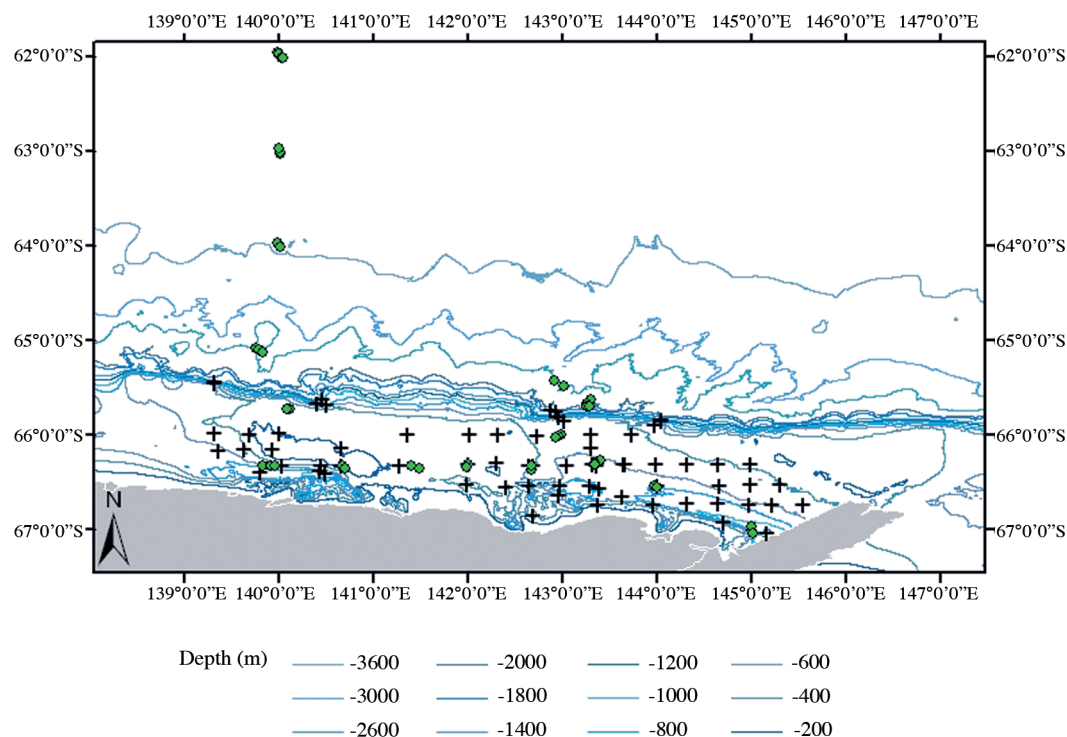


Figure 2. - CEAMARC 2008 trawl stations [Pelagic for TS *Umitaka Maru* (●) and demersal for RSV *Aurora Australis* (+)] off Terre Adélie and George V Land, Eastern Antarctica.

Study of liparid specimens

Morphoanatomy

The specimens were immediately measured and prepared for photos in the best fresh condition. Following the labeling of the specimens, a sample (skin or muscle fragment) was taken on the right side of the body and preserved in 85% ethanol for molecular studies (see below). The specimens were then either deepfrozen or fixed with formalin (10% buffered) before being transferred to alcohol (70% ethanol) to be studied for morphology. They are deposited in the collections (MNHN) as vouchers.

We refer to Burke (1930), Stein (1978), Andriashev (1986, 2003), Andriashev and Stein (1998) for methods in studying morphology of liparids. Counts (dorsal, anal, caudal fin rays and vertebrae) were taken from radiographs. Abbreviations for counts are: D, dorsal fin rays; A, anal fin rays; P, pectoral fin rays; Vert., vertebrae (including the urostyle). Measurements used are SL standard length and TL total length (in fixed specimens) with a dial calliper to the nearest 0.1 mm and/or TL, SL to the nearest mm when fresh.

As radial numbers, position, shape and presence/absence of fenestrae in the pectoral girdle are characters used to distinguish species in liparids, the right pectoral girdle of specimens of each species was removed, then cleared and stained following the method of Dingerkus and Uhler (1977). Abbreviations used are Rad. Pect., number of pectoral radials with L for Large, M for Medium, S for Small with separation of

upper and lower. The girdles were subsequently stored in glycerine alongside the collection specimen.

Comparative material

Additional liparid specimens, not previously studied and present in the collection of the Australian Antarctic Division (AAD), were included in the study as comparative material. They come from previous cruises both conducted in the Prydz Bay East Antarctic area and off the Heard and McDonald Islands (southern part of the Kerguelen Plateau). The provided numbers are AAD registration numbers but not collection numbers.

The large MNHN collection of Antarctic liparids already studied (Duhamel, 1992; Chernova and Duhamel, 2003, 2005; Duhamel and King, 2007) was also used as comparative material in the species distribution or for the species characters (collection numbers by species are provided).

Molecular study

PCR and sequencing

Muscle samples and skin samples were stored in 85% ethanol and extracted following the protocol of Winnepenninckx *et al.* (1993). The partial cytochrome oxidase I (COI) was amplified using primers FishF1-5'TCAACCAACCACAAAGACATTGGCAC3', FishF2 5'TCGACTAATCATAAAGATATCGGCAC3', FishR15' TAGACTTCTGGGTGGCCAAAGAATCA' and FishR2-

5'ACTTCAGGGTGACCGAAGAATCAGAA3' (Ward *et al.*, 2005) on Biometra thermocyclers, in a 25 μ l volume 5% of DMSO, 5 μ g of bovine serum albumin, 300 μ M of each dNTP, 0.3 μ M of Taq DNA polymerase (MP Biomedicals), 2.5 μ l of the corresponding buffer, and 1.7 pM of each of the two primers. PCRs for problematic samples were obtained with the same protocol but using the Taq DNA polymerase from Qiagen and its buffer. After denaturation for 2 minutes at 94°C, the PCR ran for 45 cycles of (20 s, 94°C; 25 s, 52°C; 45 s, 72°C), with a terminal elongation of 3 min at 72°C. Purification and sequencing of the PCRs were performed at the Genoscope (<http://www.genoscope.cns.fr/>) using the same primers. All sequences were obtained in both directions and checked manually against their chromatogram using Sequencher (Gene Codes Corporation). They were aligned by hand using Bioedit (Hall, 1999), and were controlled for mix-ups and contaminations by pairwise sequence comparison. New sequences were deposited in the Barcode of Life Database (BOLD) or GenBank when specimens were not available. BOLD process numbers/GenBank accession numbers are given in table I and II and in the text for each species studied in depth.

Sequence analyses

Publicly available sequences for liparid COI at the 15th of June 2009 were retrieved from GenBank and the BOLD.

The following sequences were included: *Acantholiparis opercularis* TZFPA129-06; *Careproctus attenuatus* TZFPA103-06, TZFPA102-06; *C. canus* TZFPA034-06, TZFPB867-08, TZFPA070-06, TZFPA113-06; *C. cypselurus* TZFPA142-06, TZFPA136-06, TZFPA135-06, TZFPA134-06, TZFPA133-06, TZFPA132-06, TZFPA131-06, FMV285-08, TZFPA101-06; *C. furcellus* TZFPB292-05, TZFPB291-05, TZFPB290-05, TZFPB418-05, TZFPB413-05, TZFPB312-05, TZFPA010-06; *C. georgianus* TZFPA097-06, TZFPA096-06, GBGC7224-09, GBGC7223-09, GBGC7222-09, GBGC7221-09; *C. melanurus* TZFPA144-06, TZFPA143-06, TZFPB321-05, TZFPB268-05, TZFPB264-05, GBGC4113-08; *Elassodiscus caudatus* TZFPB863-08, TZFPB862-08; *Liparis dennyi* TZFPB889-08, FMV231-08, FMV234-08, FMV134-08, FMV232-08; *L. fabricii* GBGC5054-08; *L. florum* FMV169-08; *L. fucensis* FMV399-08, FMV233-08; *L. gibbus* GBGC5053-08; *L. mucosus* FMV246-08, FMV248-08, GBGC4112-08; *L. pulchellus* TZFPA186-07, TZFPA185-07, FMV249-08, TZFPA184-07, TZFPA183-07, FMV218-08, TZFPA179-07; *L. rutteri* FMV245-08; *Lipariscus nanus* TZFPB861-08; *Nectoliparis pelagicus* TZFPA173-07, TZFPA196-07, TZFPA194-07, TZFPA193-07, TZFPA192-07; *Paraliparis bathybius* GBGC7139-09; *P. dactylosus* TZFPA137-06, TZFPA069-06, TZFPA112-06, TZFPA110-06, TZFPA109-06, TZFPA108-06; *P. melanobranchius* TZFPA130-06; *P. paucidens* TZFPA049-06, TZFPA048-06, TZFPB380-05, TZFPA035-06, TZFPA124-06, TZFPA031-06; *P. pectoralis* TZFPA045-06, TZFPA044-06, TZFPA042-06, TZFPA041-06, TZFPA040-06,

TZFPB417-05, TZFPB416-05, TZFPB415-05, TZFPB414-05, TZFPA071-06, TZFPA115-06, TZFPA114-06; *P. rosaceus* TZFPA008-06, TZFPB289-05, TZFPA012-06; *P. sp.* TZFPA128-06, TZFPA125-06, TZFPA120-06, TZFPA023-06, TZFPA022-06; *P. sp.* JRAS06-106 GBGC7140-09; *P. sp.* JRAS06-296 GBGC7141-09; *Rhinoliparis attenuatus* TZFPB855-08.

They were aligned with our sequences, and checked for contamination through an NJ tree. Sequence EU200473 did not group with the other liparids, and upon investigation through blast in the BOLD appears to be identical to several *Pholidapus dybowskii* (Stichaeidae) sequences. It was therefore considered to be a contamination and removed from the dataset.

The rest of the aligned sequences were analysed using Bayesian inference (BA: MrBayes 3.1, Huelsenbeck and Ronquist, 2001) and maximum parsimony (MP: PAUP*4.0b10; Swofford, 2002). For all analyses, *Cyclopterus lumpus* and two zoarcids were used as outgroups (Dettai and Lecointre 2004, 2008). For the BA, GTR + I + C was set as model, with the default settings for the priors for the proportion of invariable sites and for the gamma shape parameter and the 1st, 2nd and 3rd codon positions as different partitions. Four analyses were run with the following parameters: four chains, 5 million generations, sampling of every 100th tree and discarding of the first 25% of the file after checking the burn-in zone was included in this interval. After checking convergence had been reached, the trees and parameters resulting from the four analyses were pooled and combined in a consensus. For the MP, heuristic searches (TBR search, 1000 replicates) and 1000 bootstrap replicates were performed on the dataset.

The intraspecific distances (mean and maximum), as well as the interspecific distance (mean and minimum, Meier *et al.*, 2008) from the closest species cluster, were calculated with MEGA (Tamura *et al.*, 2007) using the Kimura 2 Parameters model, as it is also used in the tools associated with BOLD.

RESULTS

The dataset of sequences includes 157 terminals and 668 characters. All individuals from a species are grouped together in the molecular trees (Fig. 3), except for a few specimens tentatively identified as *Careproctus georgianus* by Rock *et al.* (2008). The distance among species clusters calculated is mostly above 2%, except for a few pairs of *Paraliparis* species (*P. charcoti*-*P. leobergi*, *P. rosaceus*-*P. neelovi*). This low divergence between species has already been noticed for notothenioids with confirmed identification (Rock *et al.*, 2008, Dettai *et al.*, in press).

Several genera are included within other genera, and their validity needs to be reconsidered with additional morpholog-

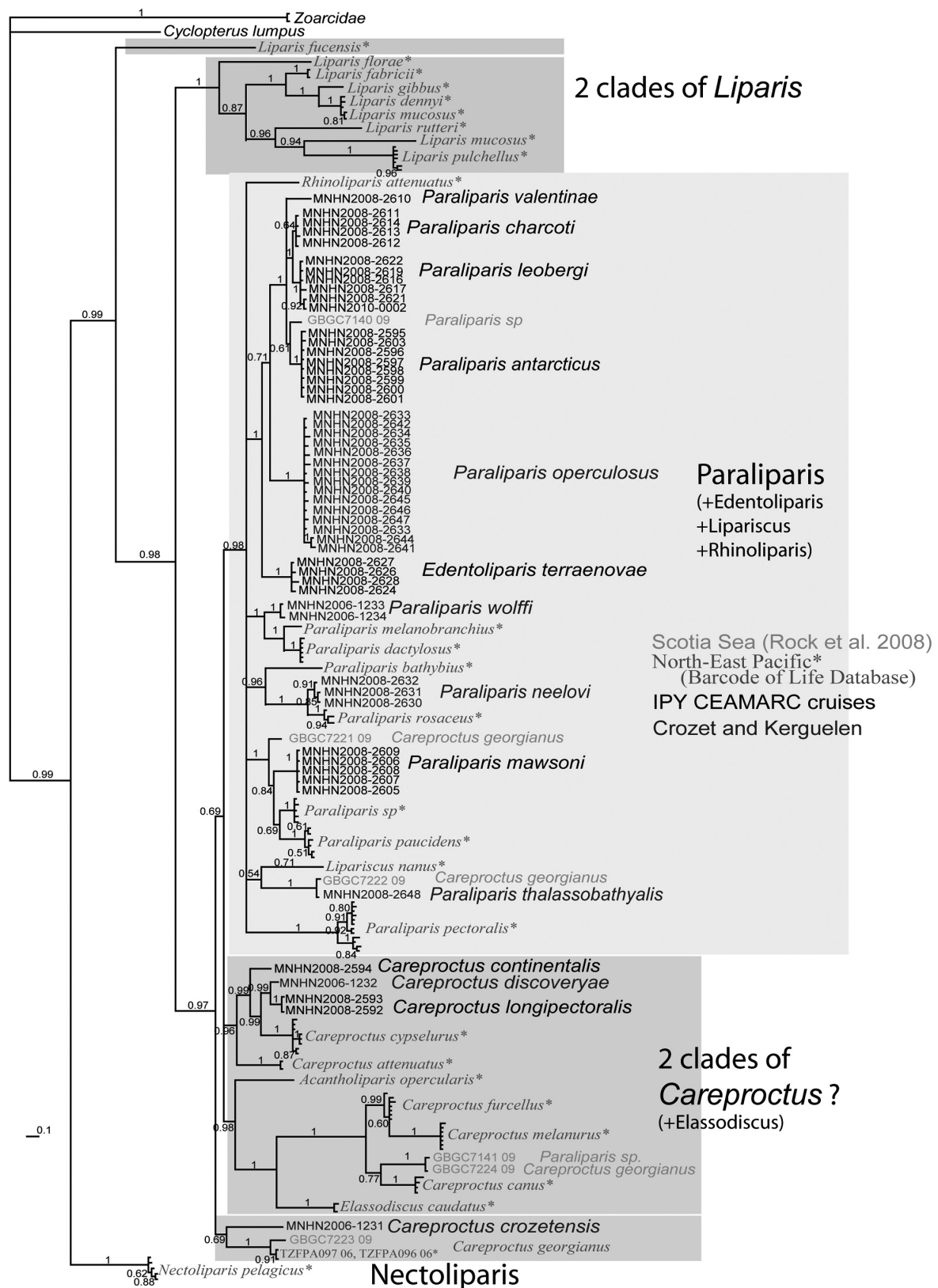


Figure 3. - Aligned sequences of liparids from POKER 2006 and CEAMARC 2008 cruises and other available publicly data (BOLD or Genbank database).

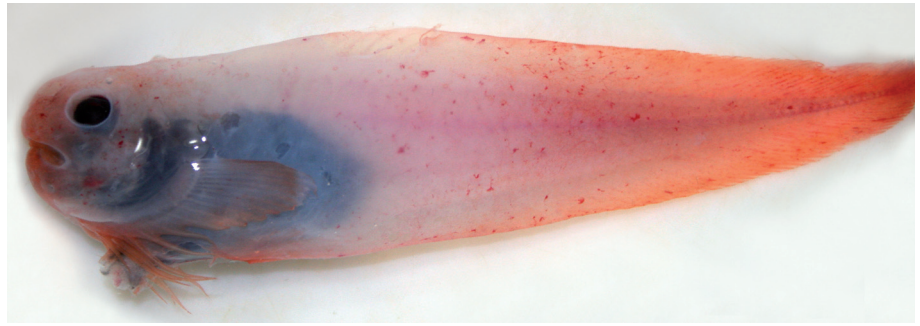


Figure 4. - *Paraliparis copei kerguelensis* Andriashev, 1982. Specimen from the station 140 POKER 2006 (115 mm LT).

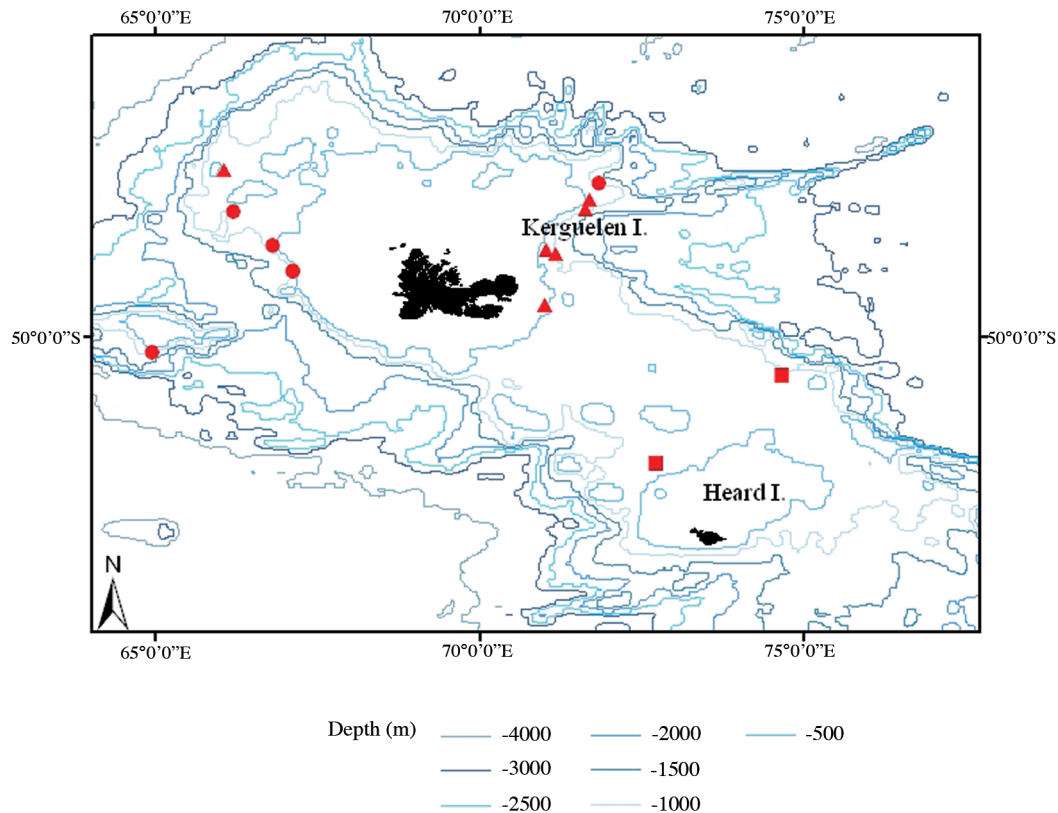


Figure 5. - Distribution of *Paraliparis copei kerguelensis* Andriashev, 1982 during POKER 2006 cruise (●) and from collection records (■ = AAD; ▲ = MNHN).

ical data, as well as nuclear molecular markers. *Edentoliparis terraenovae* (Regan, 1916) is included in genus *Paraliparis*. This genus appears monophyletic for COI with a posterior probability of 0.98 when *Rhinoliparis attenuatus* Burke, 1912 and the monotypic genera *Edentoliparis* and *Lipariscus* Gilbert, 1915 are included in it. The genus *Careproctus* forms at least two clades and might not be monophyletic, but this is not well supported and needs to be re-evaluated with additional data. The genus *Liparis* also appears to be divided in two clades, one of them formed by a single sequence from a specimen identified as *Liparis fucensis* Gilbert, 1896. Its non-monophyly is well supported by COI, but needs to be further investigated with independent data.

Sequences from specimens from North Pacific, Kerguelen and Crozet Islands, and Antarctic (both off Eastern and Western Antarctica, Terre Adélie/George V Land and from Scotia Sea) are analysed together for the first time. Six well supported (and one less well supported) clades include specimens from both the Northern Hemisphere and the Southern Ocean. Only two clades including several species are homogeneous as for the hemisphere of provenance: one of them groups 8 species of *Liparis* from North Pacific, while the other groups 7 species of *Paraliparis* (including *Edentoliparis terraenovae*) from the Southern Ocean and Kerguelen Islands.

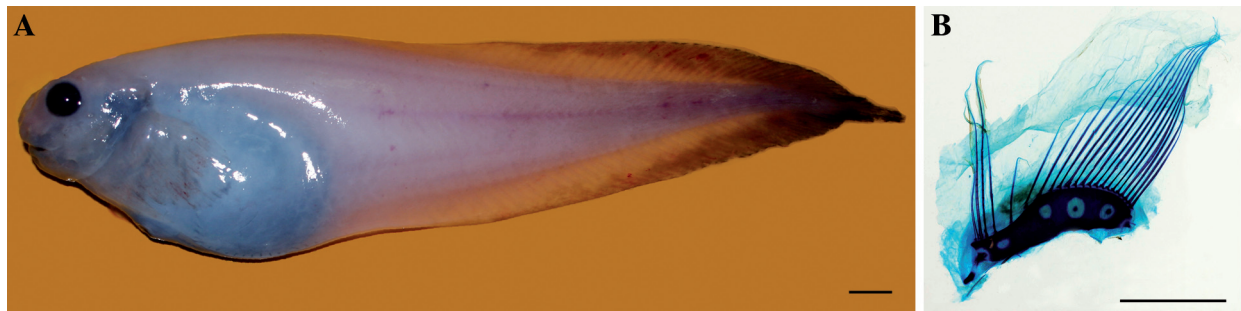


Figure 6. - A: *Paraliparis neelovi* Andriashev, 1982; MNHN 2008-2630 & 2631; B: Pectoral girdle of MNHN 2008-2631. Scale bars = 1 cm.

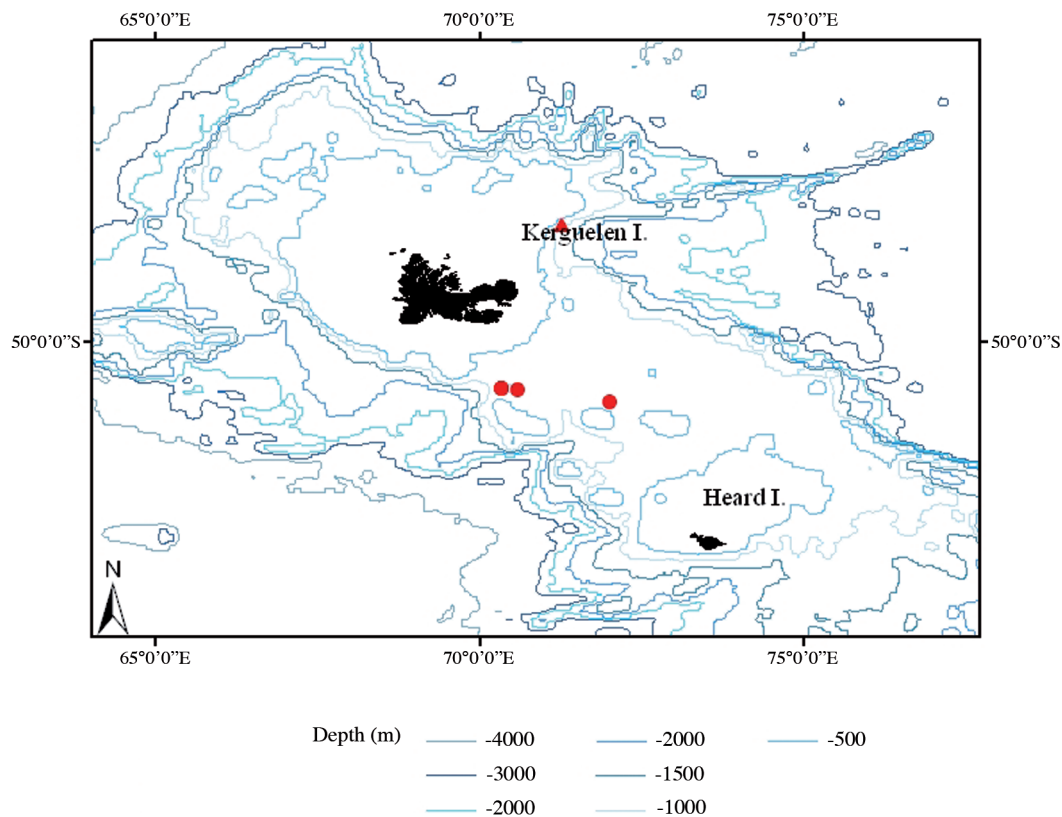


Figure 7. - Distribution of *Paraliparis neelovi* Andriashev, 1982 during POKER 2006 cruise (●) and from MNHN records (▲).

A species by species, in alphabetic order of genus and species, analysis (POKER 2006 and CEAMARC) is subsequently presented for each cruise.

POKER 2006 Cruise

The POKER 2006 Cruise resulted in the collection of five species (49 specimens) (Tab. I) belonging to one genus: *Paraliparis*.

Paraliparis copei kerguelensis Andriashev, 1982 (Fig. 4)

Six specimens (photos and data only)

POKER 2006 material, FV 'Austral', Kerguelen Islands, bottom trawl (not registered due to loss after cold storage failure). - Two specimens 115 and 145 mm TL, 24 Sept. 2006, Stn 140, 48°58,67'S, 67°08,04'E, 390-397 m; 1 spm 165 mm TL, 29 Sept. 2006, Stn 164, 48°03,63'S, 66°11,85'E, 728-774 m; 1 spm 155 mm TL, 30 Sept. 2006, Stn 166, 48°35,34'S, 66°47,99'E, 582-592 m; 1 spm 139 mm TL, 7 Oct. 2006, Stn 164, 50°13,51'S, 64°77,41'E, 468-574 m; 1 spm (? mm TL), 15 Sept. 2006, Stn 66, 47°38,04'S, 71°50,06'E, 457-459 m.

Other material (RSV 'Aurora Australis', Heard Islands, otter trawl): 2 specimens. - One specimen H900310, 159.4 mm SL, 26 May 1990, HIMS cruise, Site 1, 50°35,09'S, 74°38,96'E,

766 m; 1 spm H902205, 193.8 mm SL, 10 June 1990, KHIPPER cruise, Stn 11, 51°57.9'S, 72°43.2'E, 663 m.

MNHN collection specimens. - MNHN 1997-13; 1998-61; 2000-170 and 171, 1380 and 1381; 2002-1076. MNHN 1988-66 to 69 as *P. copei wilsoni*.

Paraliparis copei kerguelensis is a relatively large species (194 mm TL observed at Kerguelen Is.). The species has a pore-like gill opening above the upper base of pectoral fin, a high number of vertebrae but dorsal and anal fin rays are in a medium range. The relationships between sub-species (*gibbericeps*, *kerguelensis*, *wilsoni*) need to be clarified because the meristic differences appear to be weak (see Andriashev, 2003). The photo (Fig. 4) is the first one published of a fresh specimen. The gradual pink/reddish coloration of the posterior part of the body, with more intense spots, is characteristic.

The present records from POKER 2006 and additional material from Heard Is. allow the distribution to be extended to the western and southern slopes on the Plateau and the external western Skif bank (Fig. 5). It extends the previously observed distribution from the north to the eastern part of the Kerguelen shelf slope (Andriashev, 1982, 1986; Duhamel *et al.*, 2005).

No specimens could be included in the molecular study due to loss of samples.

***Paraliparis neelovi* Andriashev, 1982 (Fig. 6)**

Twelve specimens (+ 2 from photos)

FV 'Austral', POKER 2006, Kerguelen Islands, bottom trawl. - MNHN 2008-2630 and 2631, 2 spm 201.9 mm TL, 184.2 mm SL, 19 Sept. 2006, Stn 94, 50°55.65'S, 71°59.95'E, 608 m, BOLD: FKCI001-10 and FKCI002-10 respectively; MNHN 2008-2632, 160.0 mm TL, 146.9 mm SL, 20 Sept. 2006, Stn 101, 50°44.55'S, 70°34.90'E, 708 m, BOLD: FKCI003-10.

Additional POKER 2006 material, FV 'Austral' Kerguelen Islands, bottom trawl (not registered due to loss after cold storage failure). - Eight specimens: 215, 205, 202, 196, 172, 145, 137, 136 mm TL, 20 Sept. 2006, Stn 100, 50°43.23'S, 70°19.75'E, 756-766 m; 1 spm, 111 mm TL, 20 Sept. 2006, Stn 101 50°44.55'S, 70°34.90'E, 708 m.

MNHN collection specimens. - MNHN 2002-1077 and 1078.

Paraliparis neelovi is a large liparid, reaching up to 282 mm TL following the original description (Andriashev, 1982). The species exhibits a very short gill opening above the upper base of pectoral ray, a high number of dorsal, anal fin rays and vertebrae. Our specimens have a pectoral girdle with 2 (medium size) + 1 (small size) upper and 1 lower (medium size) radials. The original description however gives 2 + 1 (Andriashev, 1982, 1986). The specimens fit with the fresh colour patterns already described (Duhamel *et al.*, 2005).

The first records of the species come from the Elan seamounts (south of the Kerguelen Plateau) in the deep-sea (1070-1575 m) and the previous occurrence on the Kerguelen Plateau was from pelagic juveniles (250-350 m with a midwater trawl) over depths of 1150-1250 m (Duhamel *et al.*, 2005). Present records (Fig. 7) of relatively large specimens confirm the presence of adults in the Plateau's trough between the Kerguelen and the Heard shelves at medium depths (600-760 m). Records from the deeper sea are expected in the area. The species seems to be restricted to the Plateau and its extension to the Antarctic shelf (Banzare, Elan banks) with epibenthic adults and dispersion with local currents at the larval stages.

The sequences for this species have less than 2% divergence (Fig. 3) from specimens from North Pacific identified as *Paraliparis rosaceus*.

***Paraliparis operculosus* Andriashev, 1979 (Fig. 8)**

Twenty-eight specimens

FV 'Austral', POKER 2006, Kerguelen Islands, bottom trawl. - MNHN 2008-2633, 103.5 mm TL, 95.7 mm SL, 7 Sept. 2006, Stn 5, 46°30.57'S, 67°46.41'E, 734 m, BOLD: FKCI004-10; MNHN 2008-2634, 80.0 mm TL, 73.7 mm SL, 19 Sept. 2006, Stn 92, 50°43.10'S, 72°41.18'E, 512-515 m, BOLD: FKCI005-10; MNHN 2008-2635, 88.0 mm TL, 77.6 mm SL, 19 Sept. 2006, Stn 93, 50°54.90'S, 72°16.27'E, 582-608 m, BOLD: FKCI006-10; MNHN 2008-2636 and MNHN 2008-2637, 2 spm, 72.5 and 102.7 mm TL, 63.9 and 94.9 mm SL, 20 Sept. 2006, Stn 95, 46°30.57'S, 67°46.41'E, 541-543 m, BOLD: FKCI007-10 and FKCI008-10 respectively; MNHN 2008-2638, 98.5 mm TL, 83.9 mm SL, 20 Sept. 2006, Stn 96, 50°30.62'S, 71°55.49'E, 540-565 m, BOLD: FKCI009-10; MNHN 2008-2639 to 2643, 5 spm 102.0, 94.1, 80.9, 77.7 and 59.8 mm TL, 93.6, 87.0, 72.8, 71.3 and 52.2 mm SL, 20 Sept. 2006, Stn 98, 50°24.52'S, 71°25.47'E, 633-648 m, BOLD: FKCI010-10, FKCI011-10, FKCI012-10, FKCI013-10, and FKCI014-10; MNHN 2008-2644 and MNHN 2008-2645, 2 spm 82.0 and 65.4 mm TL, 73.6 and 58.7 mm SL, 20 Sept. 2006, Stn 99, 50°30.62'S, 70°28.09'E, 675-685 m, BOLD: FKCI015-10 and FKCI016-10; MNHN 2008-2646 and MNHN 2008-2647, 91.6 and 86.9 mm TL, 81.1 and 78.6 mm SL, 20 Sept. 2006, Stn 102, 50°47.20'S, 70°50.89'E, 684-691 m, BOLD: FKCI017-10 and FKCI018-10.

Additional POKER 2006 material, FV 'Austral', Kerguelen Islands, bottom trawl (not registered due to loss after cold storage failure). - One specimen, 125 mm TL, 15 Sept. 2006, Stn 71, 48°02.93'S, 71°31.85'E, 591-607 m; 2 spm, 65 and 86 mm TL, 19 Sept. 2006, Stn 91, 50°31.38'S, 72°35.30'E, 560 m; 2 spm 120 and 122 mm TL, 20 Sept. 2006, Stn 100 50°43.23'S, 70°19.75'E, 756-766 m; 1 spm, 60 mm TL, 21 Sept. 2006, Stn 108, 51°23.77'S, 70°20.39'E, 642-643 m; 6 spm: 87, 89, 90, 97, 101 and 108 mm TL, 29 Sept. 2006, Stn 161, 46°57.30'S, 66°20.72'E, 762-776 m; 1 spm, 67 mm TL, 29 Sept. 2006, Stn 162, 47°08.13'S, 66°07.92'E, 650-666 m.

Table I. - Size, meristic characters and pectoral girdle radials composition of liparids collected during the POKER 2006 cruise. Collection numbers and BOLD sequence numbers are provided when available.

Genus	Species	BOLD sequence number	POKER 2006 Station number	TL mm fresh	TL mm fixed	SL mm fixed	P				Pectoral girdle radii	Picture life color
collection	number						Total	sup.	int.	inf.	/	/
<i>Paraliparis</i>	<i>copei kerguelensis</i>											
/	/	/	164	165	/	/	/	/	/	/	/	/
/	/	/	166	155	/	/	/	/	/	/	/	/
/	/	/	191	139	/	/	/	/	/	/	/	/
/	/	/	140	115	/	/	/	/	/	/	/	X
/	/	/	140	145	/	/	/	/	/	/	/	/
/	/	/	66?	/	/	/	/	/	/	/	/	X
<i>Paraliparis</i>	<i>neelovi</i>											
MNHN 2008	2630	FKCI001-10	94	218	201.9	184.2	/	/	/	/	/	X
MNHN 2008	2631	FKCI002-10	94	180	160.0	146.9	22	16	3	3	2M+1S+1M	X
/	/	/	100	215	/	/	/	/	/	/	/	/
/	/	/	100	202	/	/	/	/	/	/	/	/
/	/	/	100	205	/	/	/	/	/	/	/	/
/	/	/	100	136	/	/	/	/	/	/	/	/
/	/	/	100	196	/	/	/	/	/	/	/	/
/	/	/	100	172	/	/	/	/	/	/	/	/
/	/	/	100	145	/	/	/	/	/	/	/	/
/	/	/	100	137	/	/	/	/	/	/	/	/
MNHN 2008	2632	FKCI003-10	101	206	191.3	177.7	21	15	3	3	2M+1S+1M	/
/	/	/	101	111	/	/	/	/	/	/	/	/
<i>Paraliparis</i>	<i>operculosus</i>											
MNHN 2008	2633	FKCI004-10	5	118	103.5	95.7	/	/	/	/	/	X
/	/	/	71	125	/	/	/	/	/	/	/	/
/	/	/	91	65	/	/	/	/	/	/	/	X
/	/	/	91	86	/	/	/	/	/	/	/	/
MNHN 2008	2634	FKCI005-10	92	/	80.0	73.7	/	/	/	/	/	/
MNHN 2008	2635	FKCI006-10	93	97	88.0	77.6	/	/	/	/	/	/
MNHN 2008	2636	FKCI007-10	95	82	72.5	63.9	/	/	/	/	/	/
MNHN 2008	2637	FKCI008-10	95	116	102.7	94.9	/	/	/	/	/	/
MNHN 2008	2638	FKCI009-10	96	100	93.5	83.9	/	/	/	/	/	/
MNHN 2008	2639	FKCI010-10	98	111	102.0	93.6	20	15	1	4	2L +0+ 1M	/
MNHN 2008	2640	FKCI011-10	98	101	94.1	87.0	/	/	/	/	/	/
MNHN 2008	2641	FKCI012-10	98	92	80.9	72.8	/	/	/	/	/	/
MNHN 2008	2642	FKCI013-10	98	87	77.7	71.3	/	/	/	/	/	/
MNHN 2008	2643	FKCI014-10	98	73	59.9	52.2	/	/	/	/	/	/
MNHN 2008	2644	FKCI015-10	99	115	82.0	73.6	/	/	/	/	/	/
MNHN 2008	2645	FKCI016-10	99	74	65.4	58.7	/	/	/	/	/	/
/	/	/	100	120	/	/	/	/	/	/	/	/
/	/	/	100	122	/	/	/	/	/	/	/	/
MNHN 2008	2646	FKCI017-10	102	104	91.6	81.1	20	14	2	4	2M+1S+1S	/
MNHN 2008	2647	FKCI018-10	102	95	86.9	78.6	/	/	/	/	/	/
/	/	/	108	60	/	/	/	/	/	/	/	/
/	/	/	161	97	/	/	/	/	/	/	/	/
/	/	/	161	101	/	/	/	/	/	/	/	/
/	/	/	161	90	/	/	/	/	/	/	/	/
/	/	/	161	89	/	/	/	/	/	/	/	/
/	/	/	161	108	/	/	/	/	/	/	/	/
/	/	/	161	87	/	/	/	/	/	/	/	/

Table I. - Continued.

Genus	Species	BOLD sequence number	POKER 2006 Station number	TL mm fresh	TL mm fixed	SL mm fixed	P				Pectoral girdle radii	Picture life color
							Total	sup.	int.	inf.		
/	/	/	162	67	/	/	/	/	/	/	/	/
<i>Paraliparis</i>	<i>thalassobathyalis</i>	FKCI019-10	65	/	129.5	112.6	18	10	4	4	2L +0+0	/
MNHN 2008	2648											
<i>Paraliparis</i>	sp.											
/	/	/	47	(60)	/	/	/	/	/	/	/	X
/	/	/	64?	/	/	/	/	/	/	/	/	X

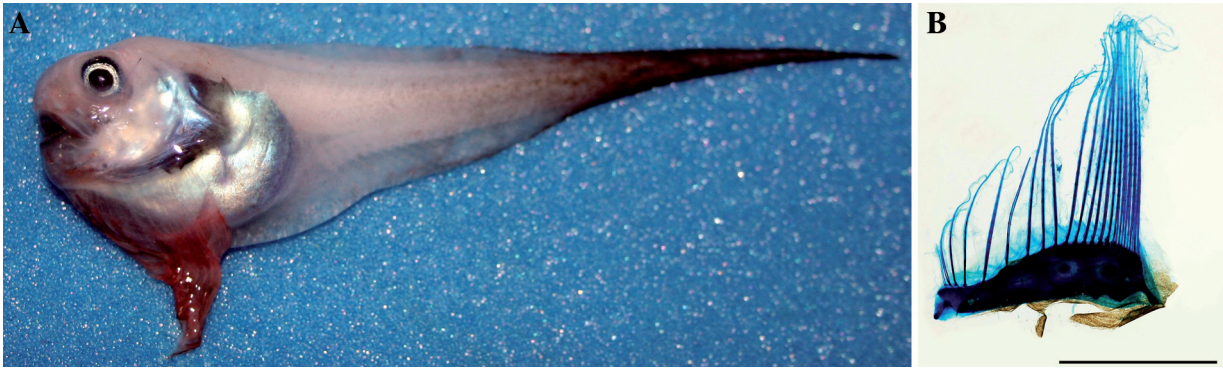


Figure 8. - **A:** *Paraliparis operculosus* Andriashev, 1979; 103.5 mm TL; MNHN 2008-2633; **B:** Pectoral girdle of MNHN 2008-2646. Scale bar = 1 cm.

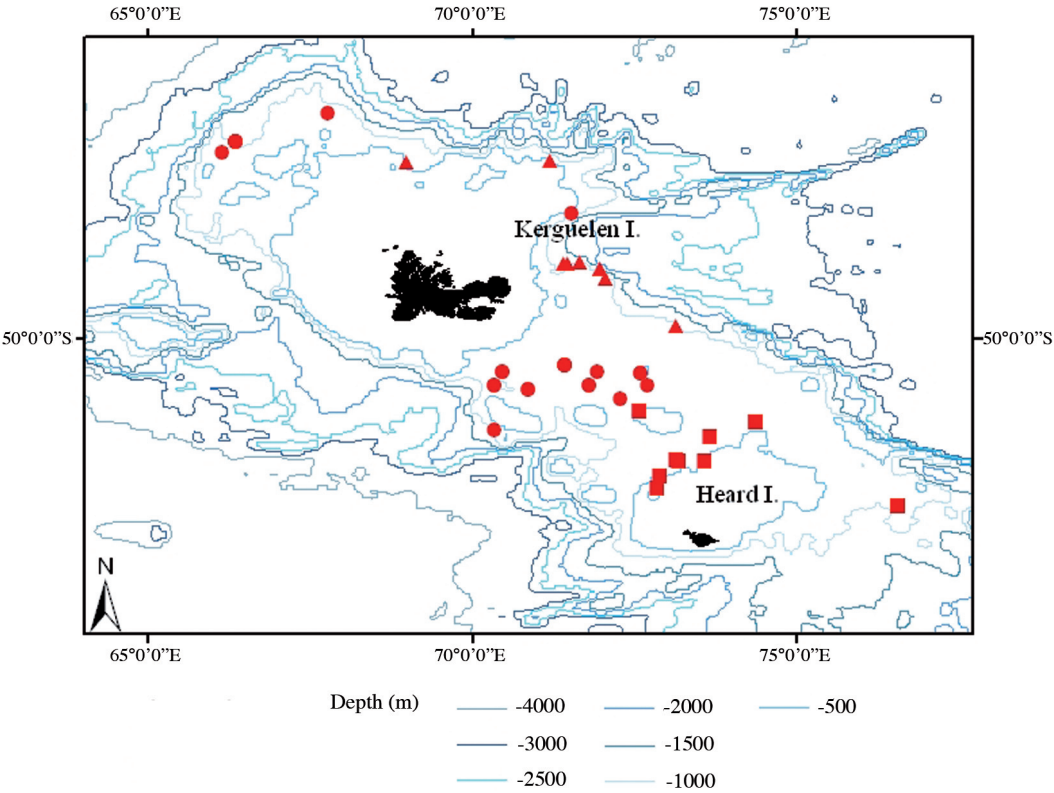


Figure 9. - Distribution of *Paraliparis operculosus* Andriashev, 1979 during POKER 2006 cruise (●) and from collection records (■ = AAD; ▲ = MNHN).

Other material (RSV 'Aurora Australis', Heard Islands, otter trawl), $n = 18$. - Seven specimens H904005 to H904011, 75.3 to 94.3 mm SL, 24 May 1990, HIMS cruise, Stn 4, 52°33,99'S, 76°33,71'E, 751-725 m; 1 spm H902037, 30.3 mm

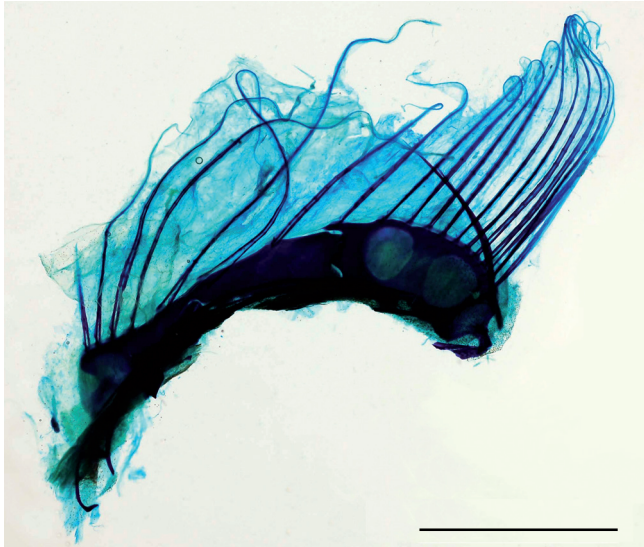


Figure 10. - Pectoral girdle of *Paraliparis thalassobathyalis* Andriashev, 1986, MNHN 2008-2648. Scale bar = 1 cm.

SL, 08 June 1990, KHIPPER cruise, Stn 78, 51°31,2'S, 73°39,5'E, 454 m; 3 spm H922938, H922940 and H922941, 62.1, 74.6 and (45) mm SL, 01 Feb. 1992, FISHOG cruise, Stn 37, 51°6,688'S, 74°12,642'E, 438 m; 2 spm H923032 and H923031, 79.5 and 80.2 mm SL, 03 Feb. 1992, FISHOG cruise, Stn 40, 51°5,92'S, 72°33,57'E, 405 m; 1 spm H923598, 65.3 mm SL, 09 Feb. 1992, FISHOG cruise, Stn 54, 52°17,47'S, 72°51,09'E, 267-260 m; 1 spm H923644, 80 mm SL, 09 Feb. 1992, FISHOG cruise, Stn 55, 51°52,08'S, 73°7,79'E, 450 m; 1 spm H923688, 87.3 mm SL, 09 Feb. 1992, FISHOG cruise, Stn 56, 51°46,435'S, 73°20,892'E, 475 m; 1 spm H932203, 48.4 mm SL, 16 Sept. 1993, THIRST cruise, Stn 39/F2, 51°52,92'S, 73°11'E, 438 m; 1 spm H932231, 92.4 mm SL, 16 Sept. 1993, THIRST cruise, Stn 40/F11, 51°58,535'S, 72°41,706'E, 683 m.

MNHN collection specimens. - MNHN 1985-534; 1985-872; 1992-291, 935, 1390, 1395; 2002-1079 to 1081 and 1266.

Paraliparis operculosus is a medium sized (maximum 125 mm TL) fish with a large opercular flap, a short gill opening reaching the level of second/third pectoral ray, 19-21 pectoral rays, a pectoral girdle exhibiting 4 radials (the two upper are largest). The photo (Fig. 8) is the first one published from a fresh specimen; the silvery coloration of iris, operculum and peritoneum (in transparency) are important characteristics for identification.

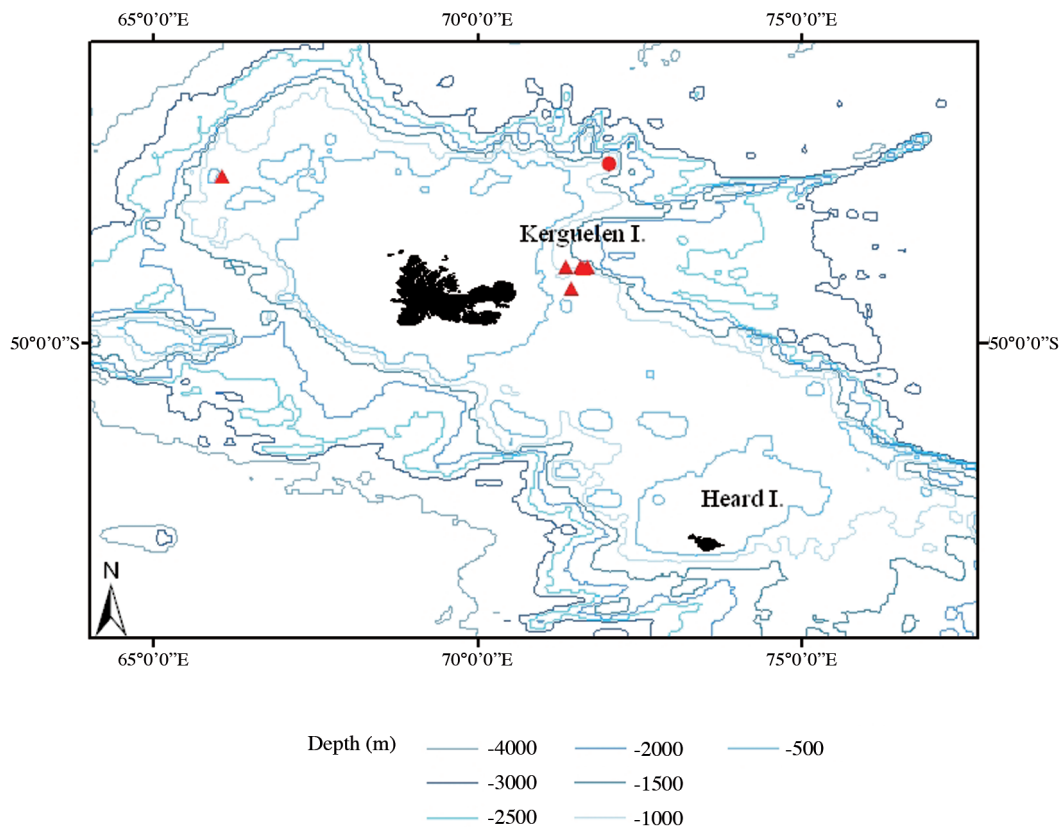


Figure 11. - Distribution of *Paraliparis thalassobathyalis* Andriashev, 1986 during POKER 2006 cruise (●) and from MNHN records (▲).

It is the most common liparid on the Kerguelen Plateau, with occurrences (Fig. 9) from the upper shelf slope to the deep-sea. Most catches occur between 500 and 700 m with a maximum record around 1295 m (Duhamel *et al.*, 2005). The geographical distribution covers the entire Plateau border, both in the northern Kerguelen Is. and southern Heard Is. shelves with numerous records during the POKER cruise in the trough between the two shelves. The epibenthic life cycle of adults is indicated by its presence in bottom gears only.

***Paraliparis thalassobathyalis* Andriashev, 1986** (Fig. 10)

FV 'Austral', POKER 2006, Kerguelen Islands, bottom trawl. - MNHN 2008-2648 129.5 mm TL, 112.6 mm SL, 15 Sept. 2006, Stn 65, 47°14,33'S, 72°01,57'E, 824-839 m, BOLD: FKCI019-10.

MNHN collection specimens. - MNHN 1985-957; 1988-71; 2000-172 and 173, 4970 and 4974; 2002-1082 to 1086.

Paraliparis thalassobathyalis is a medium size species (maximum 135 mm TL) like *P. operculosus*. The species has a small opercular flap, a short gill opening reaching the level of the first/second pectoral ray base, a low number ($10 + 4 + 4 = 18$ on the examined specimen) of pectoral fin rays. The pectoral girdle is unusual with only 2 large upper radials (Tab. I) as already described (Andriashev, 1986). A colour photo of the species has been already published (Duhamel *et al.*, 2005).

Paraliparis thalassobathyalis was first described from a deep-sea area (1160-1575 m) nearby the Elan bank (south of the Kerguelen Plateau) (Andriashev, 1982). The distribution was later extended to the slope of the Kerguelen Plateau itself both in epibenthic and pelagic range, and finally to the Crozet shelf slope (Duhamel, 1987; Chernova and Duhamel, 2003; Duhamel *et al.*, 2005) and Macquarie (Rid-doch *et al.*, 2001). The present record (Fig. 11) fits with the general distribution. It seems to be the only species encountered both in pelagic and near-bottom waters in the subantarctic zone.

Andriashev (2003) distinguishes two sub-species *P. thalassobathyalis thalassobathyalis* from Indian sector of Southern Ocean specimens and *P. thalassobathyalis meteorensis* from specimens of Atlantic sector (Meteor seamount). This assumption needs confirmation with additional samples. The sequences for this species had only 4 differences from the sequence of specimen GBGC7222 09 from Scotia Sea (Rock *et al.*, 2008) that had been tentatively identified as *Careproctus georgianus*. A misidentification, both in the genus and species, is probable for this Atlantic sector specimen. It would be of the highest interest to add it to the study of this species.

***Paraliparis* sp.** (lost specimens or uncertain status)

FV 'Austral', POKER 2006, Kerguelen Islands, bottom trawl. - 1 specimen (60) mm TL, 12 Sept. 2006, Stn 47, 46°59,51'S, 69°20,91'E, 729 m; 1 spm (?) mm TL, 14 Sept. 2006, Stn 64, 47°20,02'S, 71°24,78'E, 485-543 m (probably assigned to *P. neelovi* from photo).

Other material (RSV 'Aurora Australis', Heard Islands, otter trawl), 3 specimens not examined (probably assigned to *P. neelovi* or *P. copei* because of their size). - Two specimens H931965 and H931966, 288 and 120 mm TL, 8 Sept. 1993, THIRST cruise, Stn 23, 51°02,6'S, 74°47,5'E, 695 m; 1 spm H904050, 171 mm SL, 26 May 1990, HIMS cruise, site 1, 50°35,09'S, 74°38,96'E, 766 m.

From these results, no liparid species occurs on the shelf zone of the Kerguelen Plateau; the family appears to be restricted in the deep-sea over the slope and the trough between Kerguelen and Heard shelves. Even if the selectivity of trawls allowed the smallest individuals to escape in the POKER survey cruise, liparids are not rare at bathyal depths with 49 registered specimens. One species (*P. operculosus*) generated half of the records.

CEAMARC cruises

Two genera (Tab. II) were collected during the CEAMARC cruises: The first one, *Careproctus*, with a typical sucking disk, included two species (3 specimens). Six other species (38 specimens) are assigned to the second genus, *Paraliparis*.

Off the Antarctic shelf in front of Terre Adélie and George V Land, the midwater investigations were unsuccessful in finding liparids in most of the stations. Only 3 specimens, from a single species (*P. terraenovae*), were found. The near bottom survey with beam trawls was more efficient with a catch of 38 specimens of eight species belonging to the two genera (*Careproctus* and *Paraliparis*). Two species, *P. antarcticus* and *P. leobergi*, are the most numerous (half of the total catch) with 10 specimens each.

***Careproctus continentalis* Andriashev & Prirodina, 1990** (Fig. 12)

One specimen

RSV 'Aurora Australis', CEAMARC, Terre Adélie and George V Land, beam trawl. - MNHN 2008-2594, 60.5 mm TL, 53.5 mm SL, 18 Jan. 2008, Stn 79, 65°42,4'S, 140°35,8'E, 424-666 m, BOLD: EATF525-10.

MNHN collection specimens. - MNHN 1991-355.

The elongated specimen, again with the typical disk of *Careproctus* species, have a relatively well developed opercular flap and a short gill slit extending to the upper base of the pectoral fin. The pectoral fin is not notched, the rays decreasing sharply in size only at the end (total 29) (Tab. II). The meristic counts are the lowest of the collected speci-

Table II. - Size, meristic characters and pectoral girdle radials composition of liparids collected during the CEAMARC 2008 cruises. Collection numbers and BOLD sequence numbers are provided when available. P: pectoral fin; vert: vertebrae; A: anal fin; D: dorsal fin.

Genus	Species	BOLD sequence	Station	fresh TL mm	fresh SL mm	fixed TL mm	fixed SL mm	X-ray count						Pectoral girdle radii	Picture life color	
								P total	sup.	int.	inf.	D	A			vert
<i>Careproctus</i> MNHN 2008	<i>continentalis</i> 2594	EATF525-10	79	63	56	61,0	54,2	31	18	4	7	47	40	50	2M+0+1M	/
		EATF504-10	84	114	104	105,9	95,5	25	13	4	8	52	45	57	1M (+1S)+0+(1S)	x
		EATF268-10	66	45	44	45,5	41,3	25	14	4	7	(51)	(43)	56	1M (+?1S) + 0+1S	x
<i>Paraliparis</i> MNHN 2008	<i>antarcticus</i> 2595	EATF538-10	45	188	170	174,3	158,6	26	19	3	4	65	59	70	2L+2S+1L	x
		EATF397-10	70	190	174	173,0	157,1	22	14	5	3	64	59	70	/	x
		EATF398-10	70	172	157	/	(148,9)	24	16	5	3	64	59	70	2L+0+1L	x
		EATF399-10	70	/	/	150,9	137,4	25	15	6	4	(C cut)	(C cut)	(C cut)	/	x
		EATF443-10	16	131	118	119,1	107,1	25	15	6	4	65	60	>66	2L+0+1L	/
		EATF550-10	19	/	/	115,9	104,4	24	13/14	6	3/4	68	61	>69	/	/
		EATF075-10	38	111	102	106,5	93,1	27	18	4/5	3/4	63	58	69	/	x
		EATF472-10	19	110	101	96,0	86,7	23	15	5	3	65	60	71	2M+1M+1M	/
		EATF388-10	71	104	95	92,4	84,2	24	14/15	5	3/4	65	56	70	/	/
		/	57	/	/	59,6	55,8	(?)	18	4	(?)	(?)	(?)	(?)	2M+1M+1M	/
<i>Paraliparis</i> MNHN 2008	<i>charcoti</i> 2611	EATF582-10	36	/	/	87,3	80,4	20	14	3	3	49	45	56	/	x
		EATF392-10	71	97	86	90,2	80,2	20	15	2	3	53	47	58	1M+0+0+1M	/
		EATF190-10	57	80	73	78,5	69,1	21	15	3	3	50	46	56	2M+0+1M	/
		EATF551-10	16a	/	/	35,0	32,1	20	14	3	3	?	?	(54-56)	2M+0+1M	x
<i>Paraliparis</i> MNHN 2008	<i>leobergi</i> 2615	/	26	128	110	(118)	(103,3)	26	18	3	5	50	45	56	2M+1M+1M	x
		EATF356-10	12	126	119	111	100	24	17	3	4	52	44	>55	2M+1M(+1S)+1M	/
		EATF481-10	20	89	81	78,9	(72,5)	25	17	3	5	50	45	55	/	x
		/	35	/	/	70,3	62,4	25	18	3	4	52	45	55	2M+1M+1M	/
		EATF106-10	4	75	66	68	59	(31)	(22)	(3)	(6)	51	46	55	2M+1M+1S	/
		/	8	/	/	65,4	57,8	25	19	2	4	52	45	55	/	/
		EATF546-10	51	/	/	54,5	50,1	24	18	3	3	50	46	55	/	x
		EATF547-10	26	50	45	48,6	46,9	24	16	3	5	51	45	56	/	x
		/	48	/	/	19,2	17,6	?	?	?	?	?	?	?	/	/
		EATF022-10	27	31	/	28,4	28,4	/	/	/	/	/	/	/	/	/

Table II. Continued.

Genus collection	Species number	BOLD sequence	Station <i>Aurora Australis</i>	fresh TL mm	fresh SL mm	fixed TL mm	fixed SL mm	X-ray count						Pectoral girdle radii	Picture life color
								P total	sup.	int.	inf.	D	A	vert	
<i>Paraliparis</i> MNHN 2008	<i>mawsoni</i> 2605	EATF089-10	61	169	155	157,4	140,9	23	17	3	3	62	55	67(2 joined)	1M+2S+1M
	2606	EATF167-10	49	160	145	146,7	132,7	23	16	3	4	61	56	68	2M+1S+1M
	2607	EATF545-10	32	105	97	95,0	87,2	24	17	3	4	65	60	71	2M+1S+1M
	2608	EATF305-10	33	47	43	47,1	43,1	24	16	4	4	?	44	(?)	?2M+0
	2609	EATF302-10	49	/	/	51,0	48,9	23	16	4	3	?	?	(?)	?2M+0
<i>Paraliparis</i> MNHN 2008	<i>terraenovae</i> 2625	/	45	/	/	/	52,5	14	9	2	3	(46)	(43)	56	/
	2626	EATF471-10	19	/	/	57,9	51	13	8	3	2	52	48	55	1M+0+0+1M
	2627	EATF548-10	39	62	50	63,7	50,3	13	8	2	3	?	(42)	51	1M+0+0+0
	2628	EATF473-10	19	63	57	55,6	49,8	14	9	2	3	49	43	52	1L+0+0+1M
<i>Paraliparis</i> MNHN 2008	2610	EATF498-10	86	250	233	236,3	222,3	28	21	4	3	62	55	65	2L+2L
<i>Paraliparis</i> MNHN 2008	<i>terraenovae</i> 2624	EATF372-10	station UMITAKA MARU 10	/	/	63,9	58,6	15	6	6	3	/	/	/	1M+0+0+1M
	2633	/	12	/	/	62,6	57,2	/	/	/	/	/	/	/	/
	2629	/	42	/	/	56,6	52,4	14	5	4	5	/	/	/	1L+0+0+1L

mens. The pectoral girdle shows two medium size upper radials and a same size lower radial.

C. continentalis is known from the Weddell Sea (Andriashev and Prirodina, 1990; Duhamel, 1992) in a depth range similar (425–600 m) to that observed in the CEAMARC catches. The present record places *C. continentalis* on the upper top of the continental slope (Fig. 13). All the records point to a circumantarctic distribution for the species. Its abundance is difficult to establish, and probably under-estimated, as the small size of this species probably allows it to escape from the commonly used gears. An epibenthic life is suspected.

Careproctus longipectoralis Duhamel, 1992 (Fig. 14)

Two specimens

RSV 'Aurora Australis', CEAMARC, Terre Adélie and George V Land, beam trawl. - MNHN 2008-2592, 107.3 mm TL, 91.3 mm SL, 16 Jan. 2008, Stn 84, Adélie Land coast, 65°26,7'S, 139°19,1'E, 1138–1231 m, BOLD: EATF504-10; MNHN 2008-2593, 44.0 mm TL, 41.3 mm SL (compressed body), 5 Jan. 2008, Stn 66, 65°45,9'S, 142°55,2'E, 1518–1767 m, BOLD: EATF268-10.

MNHN collection specimen. - MNHN 1991-356.

The two specimens, with *Careproctus* species' typical disk and a massive head, have a large oblique gill slit extending to the end of the base of upper pectoral fin rays. The mandibular symphyseal pair of pores is widely spaced. The pectoral fin is deeply notched with 13/14 long, decreasing in size, upper rays, 4 small intermediate and 7/8 long, decreasing in size, lower rays (total 24/25) (Tab. II). The pectoral girdle shows a distinct medium size upper radial (and an indistinct, close to, smaller one) and a small lower radial.

C. longipectoralis was first described from the holotype only in the Weddell Sea (Duhamel, 1992) with later additional descriptions (Chernova and Duhamel, 2005). Only one other specimen was collected since the description (Matallanas, 1998) from the same geographical origin (70°09'S, 8°33'W, 2315–2334 m Agassiz trawl, 1 March 1996, ZUAB, No 002-1997, sexually mature female, 165 mm SL). The two specimens off Terre

Adélie and George V Land appear to be juveniles as they present all morphological proportions and meristic counts of the species but lack the typical adult coloration. The coloration seems to appear first on the tip of the fins, and, later in life, extends to the rest of the body. These specimens occupy a relatively shallower bathymetric range, comparatively to the previously recorded adults, and on the external slope of the continental shelf (Fig. 13). Consequently this deep-sea species probably occupies a circumantarctic range on the

lower part of the slope and deep-sea with a life cycle close to the bottom.

The sequences for this species differ by less than 2% for COI from the sequence for the type of *Careproctus discoveryae* from the very deep sea (4267-4270 m) off the Crozet Islands (Duhamel and King, 2007). However, *C. longipectoralis* shows very distinct and lower meristic counts.

Paraliparis antarcticus Regan, 1914 (Fig. 15)

Ten specimens

RSV 'Aurora Australis', CEAMARC, Terre Adélie and George V Land, beam trawl. - MNHN 2008-2595, 174.3 mm TL, 158.6 mm SL, 29 Dec. 2007, Stn 45, 66°45.0'S, 143°57.0'E, 599-878 m, BOLD: EATF538-10; MNHN 2008-2596 to 2598, 3 spm 173.0 mm, (? Tail missing), 150.9 mm TL, 157.1, 148.8, 137.4 mm SL, 14 Jan. 2008, Stn 70, 66°24.5'S, 140°03.0'E, 1036-1204 m, BOLD: EATF397-10, EATF398-10, EATF399-10; MNHN 2008-2599, 119.1 mm TL, 107.1 mm SL, 14 Jan. 2008, Stn 16, 66°20.3'S, 140°01.8'E, 510-626 m BOLD: EATF443-10; MNHN 2008-2600, 2 spm 115.9, 96.0 mm TL, 104.4, 86.7 mm SL, 15 Jan. 2008, Stn 19, 66°10.2'S, 139°21.2'E, 652-687 m, BOLD: EATF550-10; MNHN 2008-2601, 106.5 mm TL, 93.1 mm SL, 4 Jan. 2008, Stn 38, 66°20.0'S, 143°21.4'E, 689-720 m, BOLD: EATF075-10; MNHN 2008-2602, 96.0 mm TL, 86.7 mm SL, 4 Jan. 2008, Stn 19, 66°10.2'S, 139°21.2'E, 652-687 m, BOLD:

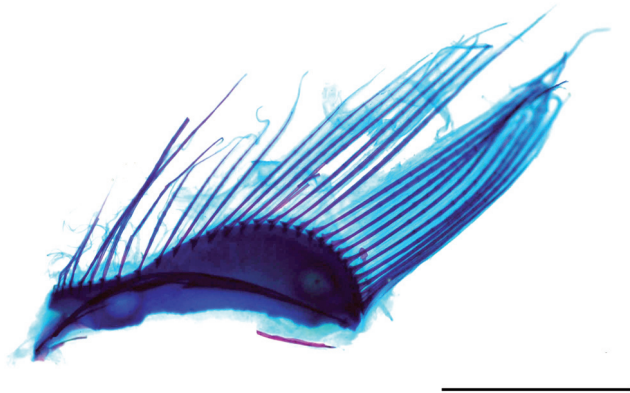


Figure 12. - Pectoral girdle of *Careproctus continentalis* Duhamel, 1992; MNHN 2008-2594. Scale bar = 0.5 cm.

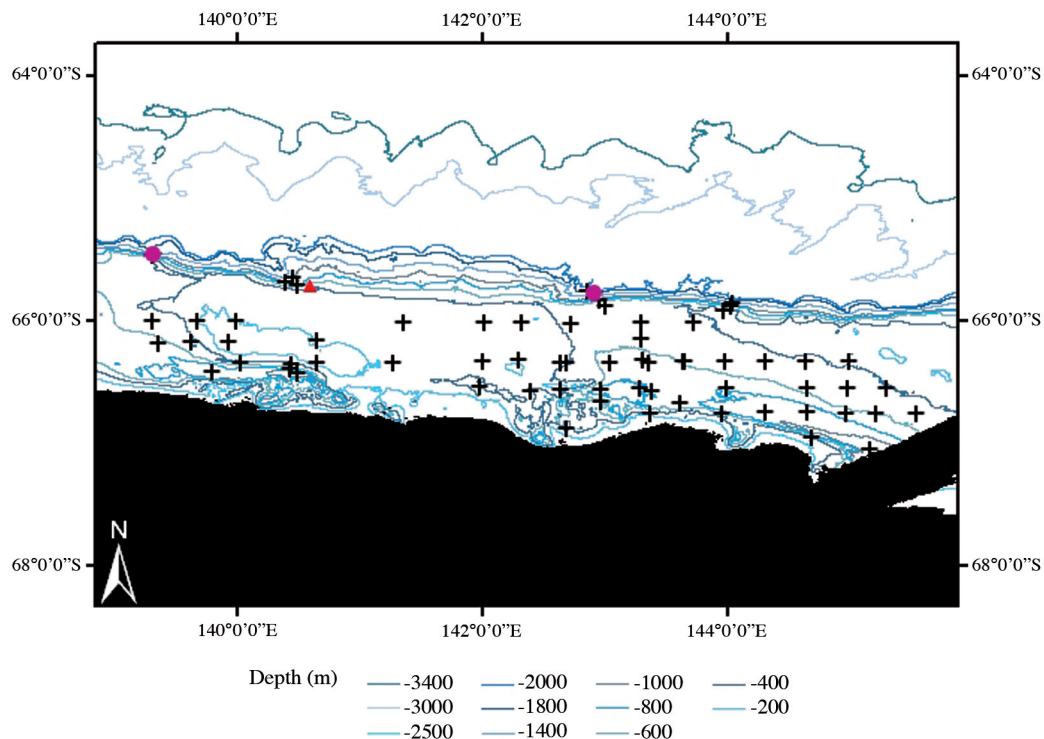


Figure 13. - Distribution of *Careproctus longipectoralis* Duhamel, 1992 (●) and *Careproctus continentalis* Duhamel, 1992 (▲) during the CEAMARC 2008 cruises. Stations CEAMARC (+).

EATF472-10; MNHN 2008-2603 92.4 mm TL, 84.2 mm SL, 14 Jan. 2008, Stn 71, 66°02,3'S, 140°25,7'E, 683-791 m, BOLD: EATF388-10; MNHN 2008-2604, 59.6 mm TL, 55.8 mm SL, 31 Dec. 2007, Stn 57, 66°44,7'S, 144°57,7'E, 632-661 m.

Other material $n = 10$. - One specimen S870262, (95) mm SL (broken), 3 March 1987, RSV Nella Dan, Bottom trawl 3mt, Prydz Bay, AAMBER 1 cruise, Stn 1, 67°20,8'S, 72°24,55'E, 562-568 m; 1 spm S919199, 185.1 mm SL, 7 Feb. 1991, RSV *Aurora Australis*, AAMBER 2 cruise, Stn 54B, Midwater trawl IYGPT (with lights), Prydz Bay, 67°54,22'S, 71°4,93'E, 450 m; 4 spm S9111919 to S91922 (broken) SL not available, 20 Feb. 1991, RSV *Aurora Australis*, AA91 cruise, Stn 83, otter trawl, Prydz Bay, 68°23,1'S, 73°48,4'E, 662 m; 1 spm T9111931, 165.1 mm SL, 21 Feb. 1991, RSV *Aurora Australis*, AA91 cruise, Stn 84, otter trawl, Prydz Bay, 68°3,77'S, 73°9,33'E, 683-680 m; 2 spm T9112858 and T9112859, 181.6 and 172 mm SL, 24 Feb. 1991, RSV *Aurora Australis*, AA91 cruise, Stn 92, otter trawl, Prydz Bay, 66°43,6'S, 71°54,47'E, 676 m; 1 spm S930068, 208.5 mm SL, 19 Jan. 1993, RSV *Aurora Australis*, KROCK cruise, Stn 20-16, Midwater trawl IYGPT, Prydz Bay, 68°28,99'S, 78°29,48'E, 600 m.

MNHN collection specimens. - MNHN 1991-339, 341, 342.

The specimens of various sizes have a very long gill slit extending ventrally to the lower part of pectoral fin base. The pectoral girdle has 2 (or 3) upper and 1 lower radials, all large (or medium size). The pectoral fin is notched with 14-19 upper long rays, 3-6 intermediate short rays and 3-4 long lower rays (total 22-27) (Tab. II). The species exhibits high values in number of vertebrae, dorsal and anal fin rays counts. The colour in live specimens varies from a light translucent pink body turning dusky towards the peritoneum (dorsal part mainly) to a gradually more intensive orange colour in the posterior part of the body. The iris is silvery, a characteristic not previously noted.

Paraliparis antarcticus is certainly the most common species of this genus in the Antarctic. The species is rather large with a maximum size reaching up to nearly 230 mm SL (Andriashev, 1986). *P. antarcticus* seems to be an epibenthic species. The circumantarctic distribution is known even if no specimens had been previously collected off Terre Adélie and George V Land. The gap (with also the present records from Prydz Bay) is now filled, and fits with the known range (Andriashev, 1986; Duhamel, 1992). The CEAMARC sample shows (Fig. 16) an interesting feature because the species occurs in relatively deep zone between 510 and 878 m (and probably deeper 1036-1204 m), and only in the depressions of the inner shelf zone.

***Paraliparis charcoti* Duhamel, 1992 (Fig. 17)**

Four specimens

RSV 'Aurora Australis', CEAMARC, Terre Adélie and George V Land, beam trawl. - MNHN 2008-2611, 87.3 mm TL, 80.4 mm SL, 4 Jan. 2008, Stn 36, 66°19,2'S, 143°39,0'E, 559-591 m, BOLD: EATF582-10; MNHN 2008-2612, 90.2 mm TL,

80.2 mm SL, 14 Jan. 2008, Stn 71, 66°02,3'S, 140°25,7'E, 683-791 m, BOLD: EATF392-10; MNHN 2008-2613, 78.5 mm TL, 69.1 mm SL, 31 Dec. 2007, Stn 57, 66°44,7'S, 144°57,7'E, 632-661 m, BOLD: EATF190-10; MNHN 2008-2614, 35.0 mm TL, 32.1 mm SL, 14 Jan. 2008, Stn 16a, 66°20,3'S, 144°01,8'E, 510-626 m, BOLD: EATF551-10.

MNHN collection specimens. - MNHN 1991-340, 349 to 352.

P. charcoti has a large opercular flap and the gill slit extends to the base of the first pectoral fin rays. A low number of rays on the pectoral fins (14-15 + 2-3 + 3, total 20-21) and low value in other fin rays and vertebrae counts are registered (Tab. II); The pectoral girdle shows 2 (1 for one specimen) upper and 1 lower, medium sized, radials. The live colour was not available in the original and additional descriptions (Duhamel, 1992; Chernova and Duhamel, 2005). The first colour photo shows a general pinkish body colour. The peritoneum, the mouth contour and the underside of the head below the eyes are bluish. A more deeply violet contour of the body is visible under the transparent gelatinous tissues. The iris is black.

P. charcoti belongs to the small sized Antarctic *Paraliparis* species, reaching about 95 mm SL. The species seems relatively common. The present depth distribution (510-791 m) fits well with the original description from the Weddell Sea (460-793 m) (Duhamel, 1992). The occurrence of the species in the Eastern Antarctic supports a circumantarctic distribution for *P. charcoti*. The CEAMARC cruises show (Fig. 18) an inner shelf distribution of *P. charcoti* close to the border of the depressions or inside them. An epibenthic life-cycle is probable both in the Weddell Sea and in the Eastern Antarctic.

There is less than 1% divergence between the sequences for COI of this species and of *Paraliparis leobergi*. The morphological differences are perfectly correlated with the groups based on the molecular results, so this low divergence seems to be a legitimate interspecific divergence.

***Paraliparis leobergi* Andriashev, 1982 (Fig. 19)**

Ten specimens

RSV 'Aurora Australis', CEAMARC, Terre Adélie and George V Land, beam trawl. - MNHN 2008-2615, (118.0) mm TL, (103.3) mm SL (compressed body), 13 Jan. 2008, Stn 26, 66°31,0'S, 140°08,5'E, 176-288 m; MNHN 2008-2616, 110.9 mm TL, 100.0 mm SL, 13 Jan. 2008, Stn 12, 66°33,6'S, 140°47,8'E, 151-361 m, BOLD: EATF356-10; MNHN 2008-2617, (78.9) mm TL, (72.5) mm SL (compressed body), 15 Jan. 2008, Stn 20, 65°59,4'S, 139°59,7'E, 189-196 m, BOLD: EATF481-10; MNHN 2008-2618, 70.3 mm TL, 62.4 mm SL, 4 Jan. 2008, Stn 35, 66°19,3'S, 143°58,6'E, 632-661 m; MNHN 2008-2619, 68.0 mm TL, 59.0 mm SL, CEAMARC, 26 Dec. 2007, Stn 4, 66°19,0'S, 142°02,2'E, 237-257 m, BOLD: EATF106-10; MNHN 2008-2620, 65.4 mm TL, 57.8 mm SL, CEAMARC, 26 Dec. 2007, Stn 8, 66°33,9'S,

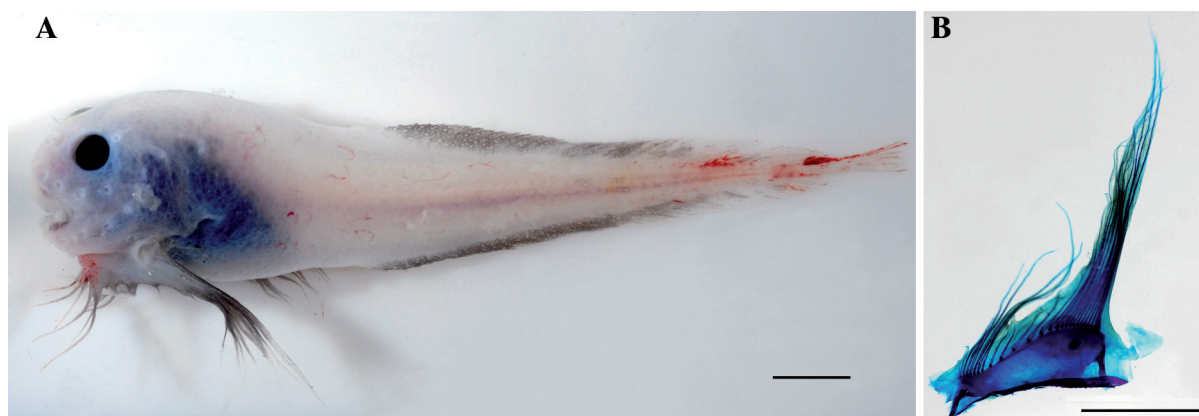


Figure 14. - **A:** *Careproctus longipectoralis* Duhamel, 1992; MNHN 2008-2592; **B:** Pectoral girdle. Scale bars = 1 cm.

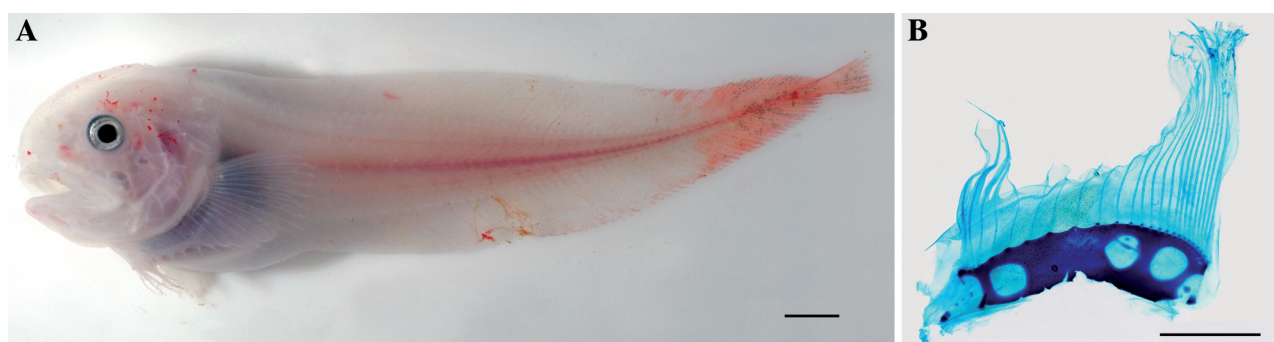


Figure 15. - **A:** *Paraliparis antarcticus* Regan, 1914; MNHN 2008-2598; **B:** pectoral girdle of MNHN 2008-2597. Scale bars = 1 cm.

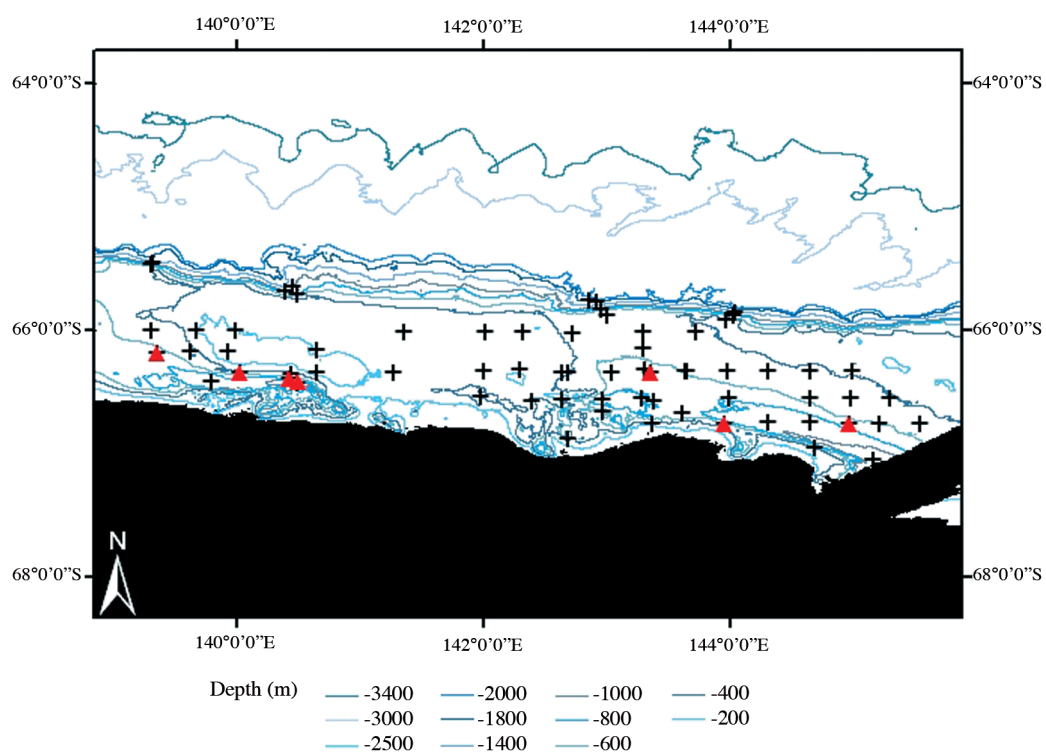


Figure 16. - Distribution of *Paraliparis antarcticus* Regan, 1914 (▲) during the CEAMARC 2008 cruises. Stations CEAMARC (+)

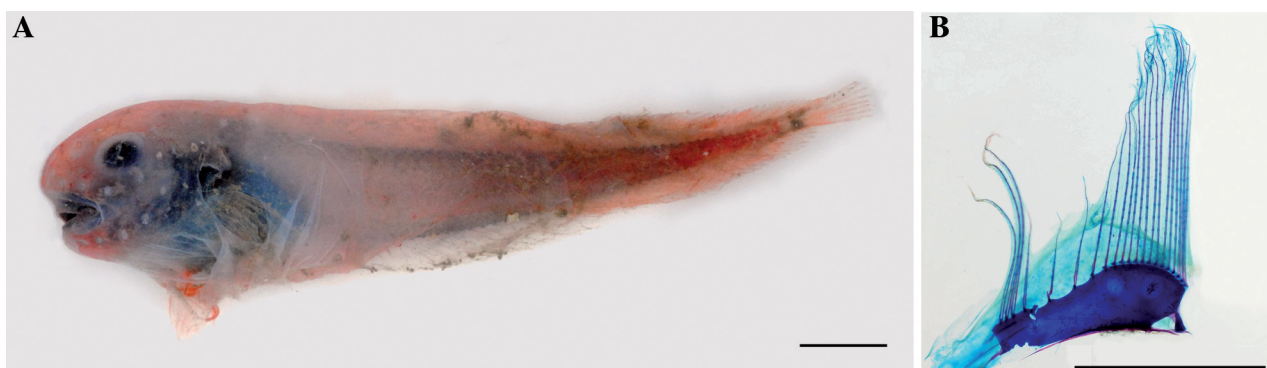


Figure 17. - **A:** *Paraliparis charcoti* Duhamel, 1992; MNHN 2008-2611; **B:** Pectoral girdle of MNHN 2008-2613. Scale bars = 1 cm.

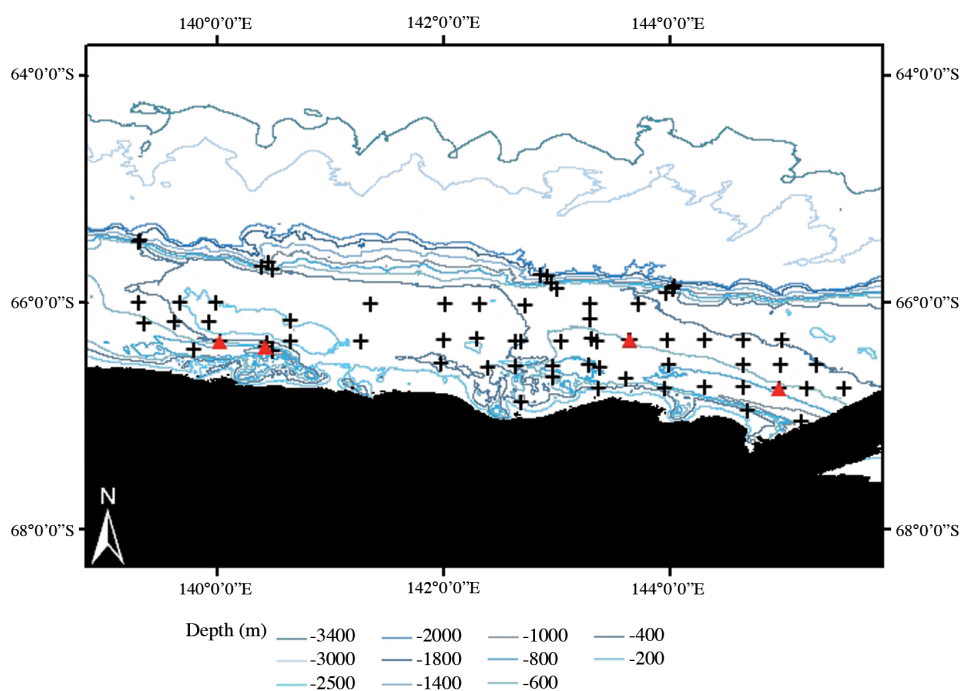


Figure 18. - Distribution of *Paraliparis charcoti* Duhamel, 1992 (▲) during the CEAMARC 2008 cruises. Stations CEAMARC (+).

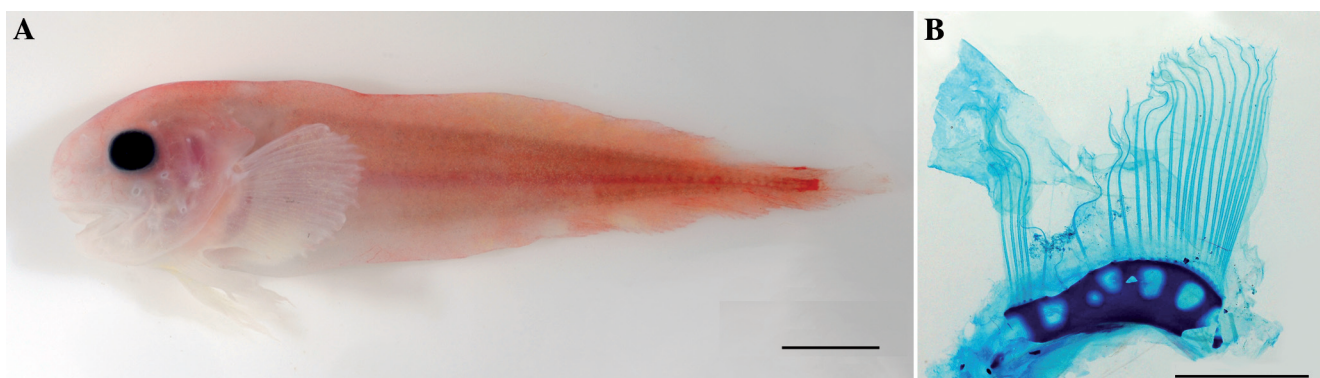


Figure 19. - **A:** *Paraliparis leobergi* Andriashev, 1982; MNHN 2008-2621; **B:** pectoral girdle of MNHN 2008-2616. Scale bars = 1 cm.

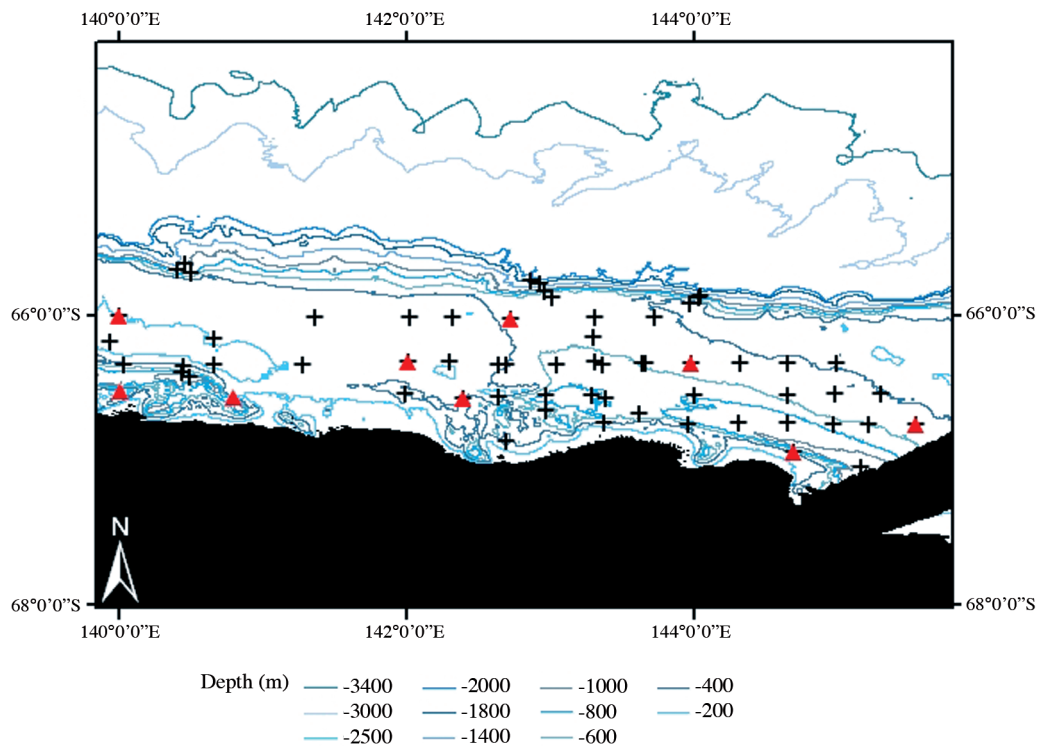


Figure 20. - Distribution of *Paraliparis leobergi* Andriashev, 1982 (▲) during the CEAMARC 2008 cruises. Stations CEAMARC (+).

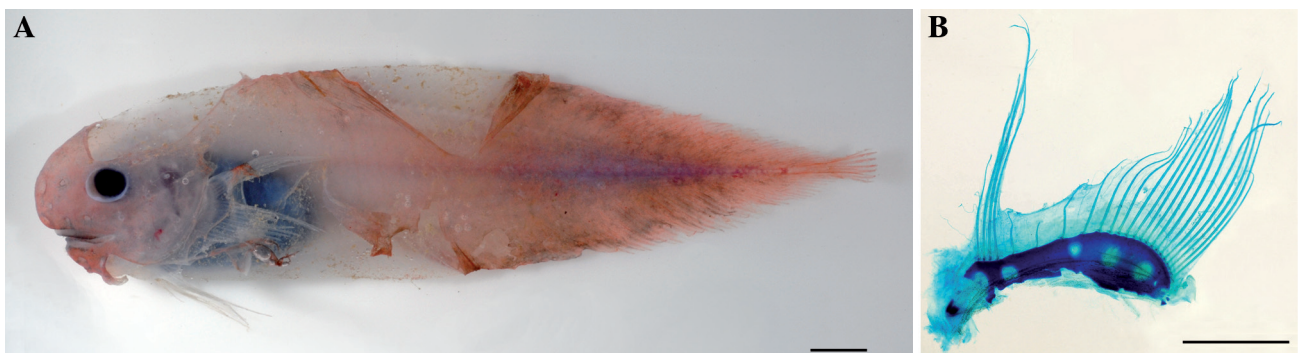


Figure 21. - **A:** *Paraliparis mawsoni* Andriashev, 1986; MNHN 2008-2606; **B:** Pectoral girdle. Scale bars = 1 cm.

142°23,2'E, 365-386 m; MNHN 2008-2621 54.5 mm TL, 50.1 mm SL, 30 Dec. 2007, Stn 51, 66°45,0'S, 145°32,1'E, 525-553 m, BOLD: EATF546-10; MNHN 2008-2622, 48.6 mm TL, 46.9 mm SL, 13 Jan. 2008, Stn 26, Adélie Land coast, 66°31,0'S, 140°08,6'E, 176-288 m, BOLD: EATF547-10; MNHN 2008-2623, 19.2 mm TL, 17.6 mm SL, 29 Dec. 2007, Stn 48, 66°56,4'S, 144°41,1'E, 325-409 m; MNHN 2010-0002, 28.4 mm TL, 23.3 mm SL, 13 Jan. 2008, Stn 27, 66°08,3'S, 142°43,0'E, 419-455 m, BOLD: EATF022-10.

Other material n = 1 (not examined). - One specimen T913028, 88 mm SL, 28 Feb. 1991, RSV *Aurora Australis*, AA91 cruise, Stn 100, otter trawl, Mawson coast, 67°27,4'S, 68°50,3'E, 150 m.

MNHN collection specimens. - MNHN 1991-345 to 438.

The specimens of this relatively small and slender species

have 3 (one specimen with 2) distinct notch rays on the pectoral fin (total 24-26 rays) and a gill slit extending to the base of the first rays (3 to 4). The pectoral girdle shows 3 upper (one specimen with additional smaller one) and 1 lower medium sized radials (Tab. II). The live colour of the body corresponds well to the description of Andriashev (1986). The pinkish colour of the body and a black iris can be added to the already described characteristics. The observed size range (19 to 118 mm SL in the sample) fits with the previous registered maximum size of 110 mm SL (Andriashev, 2003).

Paraliparis leobergi is the species caught in the shallowest waters (151-553 m) during the CEAMARC survey. It has a large distribution over the shelf and nearby the inner depressions but not close to or on the shelf break (Fig. 20).

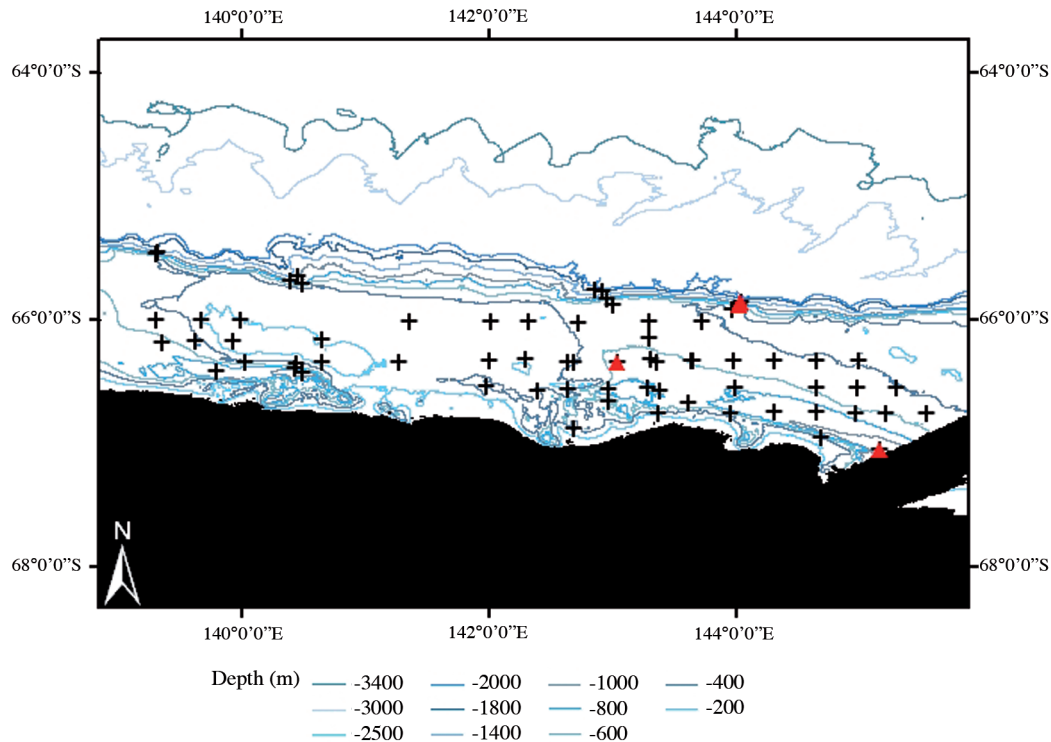


Figure 22. - Distribution of *Paraliparis mawsoni* Andriashev, 1986 (▲) during the CEAMARC 2008 cruises. Stations CEAMARC (+).



Figure 23. - **A:** *Paraliparis terraenovae* Regan, 1916; MNHN 2008-2627; **B:** Pectoral girdle of MNHN 2008-2626. Scale bars = 1 cm.

Its depth occurrence seems to be the same as in other parts of the Southern Ocean (Andriashev, 1986, 2003 and additional material). As it is also known from the Weddell Sea to Prydz Bay (Duhamel, 1992), the occurrence off Terre Adélie and George V Land hints at a full circumantarctic distribution of this relatively common species. An epibenthic lifecycle seems confirmed.

***Paraliparis mawsoni* Andriashev, 1986 (Fig. 21)**

Five specimens

RSV 'Aurora Australis', CEAMARC, Terre Adélie and George V Land, beam trawl. - MNHN 2008-2605, 157.4 mm TL, 149.0 mm SL, 25 Dec. 2007, Stn 61, 66°20,1'S, 143°02,2'E,

557-689 m, BOLD: EATF089-10; MNHN 2008-2606 and 2609, 2 spm 146.7, 51.0 mm TL, 132.7, 48.9 mm SL, 30 Dec. 2007, Stn 49, 67°42,4'S, 145°02,8'E, 1051-1352 m, BOLD: EATF167-10 and EATF545-10 respectively; MNHN 2008-2607, 95.0 mm TL, 87.2 mm SL, 12 Jan. 2008, Stn 32, 65°51,2'S, 140°02,4'E, 953-1194 m, BOLD: EATF305-10; MNHN 2008-2608, 47.1 mm TL, 43.1 mm SL, 12 Jan. 2008, Stn 33, 65°52,1'S, 144°01,7'E, 634-816 m, BOLD: EATF302-10.

MNHN collection specimens. - MNHN 1991-343 and 344.

Paraliparis mawsoni exhibits high values in vertebrae numbers (67-71), dorsal (61-65) and anal (55-60) fin rays counts but intermediate values in pectoral fin rays (16-17 + 3-4 + 3-4, total 23-24). The closely set arrangement of the mandibular symphyseal pair of pores and a short gill slit

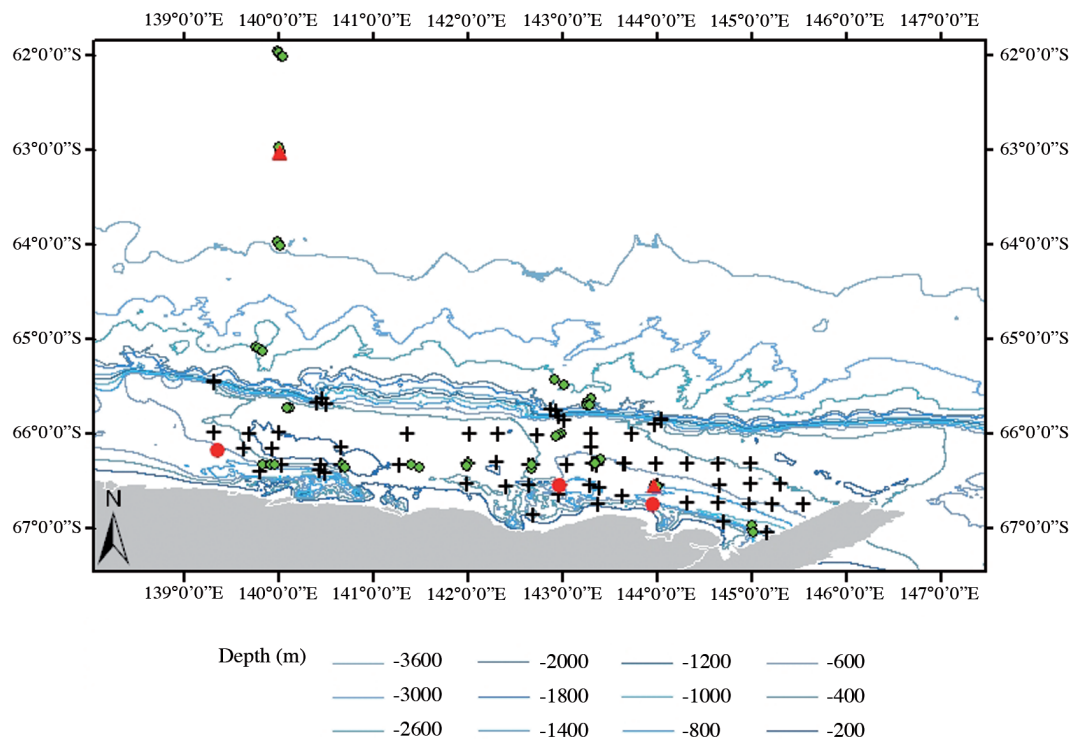


Figure 24. - Distribution of *Paraliparis terraenovae* Regan, 1916 during the CEAMARC 2008 cruises. (●) *Paraliparis terraenovae* Aurora Australis; (▲) *Paraliparis terraenovae* Umitaka Maru; (●) stations Umitaka Maru YGPT; (+) stations Aurora Australis.



Figure 25. - **A:** *Paraliparis valentinae* Andriashev and Neelov, 1984; MNHN 2008-2610; **B:** Pectoral girdle. Scale bars = 1 cm.

(not extending further than the base of the first pectoral rays) are also characteristic. The pectoral girdle includes 2 medium sized, and a smaller third one, upper + 1 lower radials (Tab. II). The first photos of fresh specimens allow us to specify the colour pattern of *P. mawsoni*. The general body colour is pinkish. The terminal edge of posterior anal and dorsal fins are more intensely coloured. The peritoneum is bluish-lilac. The same colour can be distinguished through the skin for the terminal part of the body. The eye is entirely black.

Paraliparis mawsoni is a medium sized Antarctic *Paraliparis* species, reaching 190 mm SL. All the previous records of *P. mawsoni* are from the Lazarev Sea and Western Antarctica (Andriashev, 1986; Duhamel, 1992; Matallanas, 1999).

The occurrence in CEAMARC samples (Fig. 22), both from inner continental shelf depressions and on the slope, spreads the distribution to Eastern Antarctica and thus supports a circumantarctic range. An extension of the bathymetric range (557-1352 m) from the previous records (735-1080 m) must be noted. An epibenthic life cycle is probable.

Paraliparis terraenovae Regan, 1916 (Fig. 23)

Seven specimens

CEAMARC, Terre Adélie and George V Land. - MNHN 2008-2624, 63.9 mm TL, 58.6 mm SL, TS Umitaka Maru, CEAMARC, 30 Jan. 2008, midwater trawl IYGPT, Stn 10, 63°01,6068'S, 140°0,3581'E, 200 m over depths of 3724-

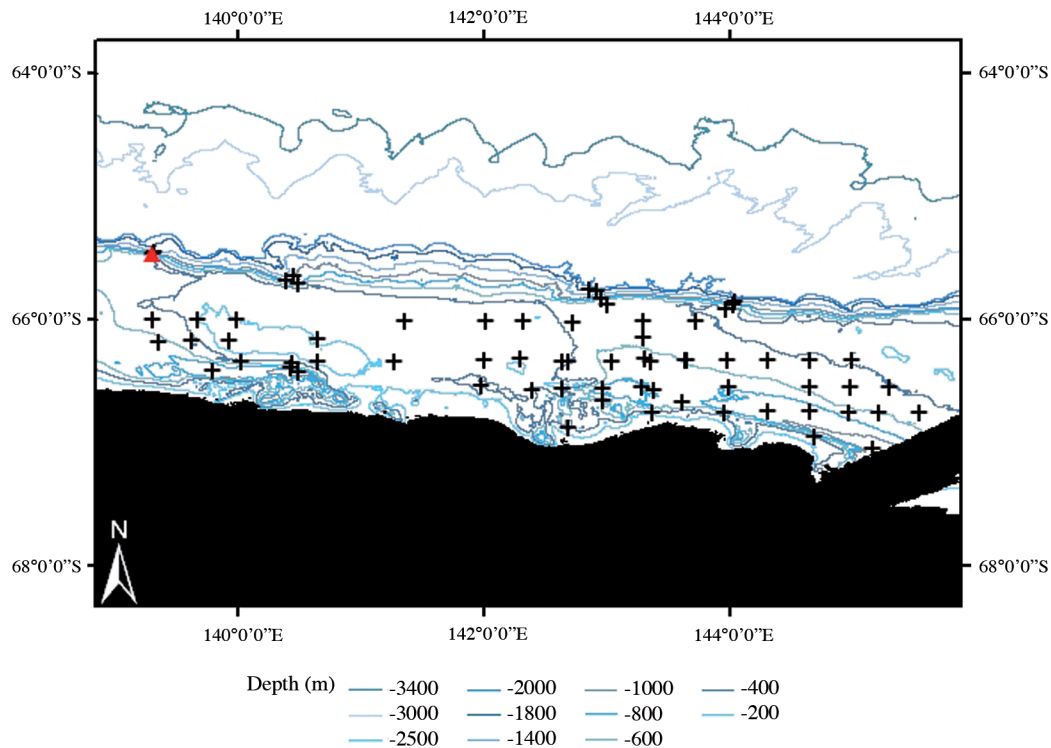


Figure 26. - Distribution of *Paraliparis valentinae* Andriashev & Neyelov, 1984 (▲) during the CEAMARC 2008 cruises. Stations CEAMARC (+).

3804 m, BOLD: EATF-372-10; MNHN 2008-2625 52.5 mm SL, RSV *Aurora Australis*, CEAMARC, 29 Dec. 2007, beam trawl, Stn 45, 66°45,0'S, 143°57,0'E, 599-878 m; MNHN 2008-2626 2 spm 57.9, 55.6 mm TL, 51.0, 49.8 mm SL, RSV *Aurora Australis*, CEAMARC, 15 Jan. 2008, beam trawl, Stn 19, 66°10,2'S, 139°21,2'E, 652-687 m, BOLD: EATF471-10; MNHN 2008-2627; 63.7 mm TL, 50.3 mm SL, RSV *Aurora Australis*, CEAMARC, 27 Dec. 2007, beam trawl, Stn 39, 66°33,0'S, 144°57,5'E, 862-875 m, BOLD: EATF548-10; MNHN 2008-2628; 55.6 mm TL, 49.8 mm SL, RSV *Aurora Australis*, CEAMARC, 15 Jan. 2008, beam trawl, Stn 19, 66°10,2'S, 139°21,2'E, 652-687 m, BOLD: EATF473-10; MNHN 2008-2629, 56.6 mm TL, 52.4 mm SL, TS *Umitaka Maru*, CEAMARC, 30 Jan. 2008, midwater trawl IYGPT, Stn 42, 66°33,7649'S, 143°59,2648'E, 500 m over depths of 792-796 m; MNHN 2008-2633, 62.6 mm TL, 57.4 mm SL, TS *Umitaka Maru*, CEAMARC, 10 Feb. 2008, midwater trawl IYGPT, Stn 12, 63°01,9112'S, 140°0,6727'E, 1000 m over depths of 3387-3394 m.

Other material $n = 19$. - One specimen S870092, 65.5 mm SL, 18 Feb. 1987, Nella Dan, AAMBER I cruise, Stn 6, otter trawl, Prydz Bay, 68°33,1'S, 76°58,1'E, 729-733 m; 2 spm S870106 and S870107, 75 and 54 mm SL, 18 Feb. 1987, Nella Dan, AAMBER I cruise, Stn 7, otter trawl, Prydz Bay, 68°40,8'S, 77°11,1'E, 578 m; 7 spm S9118528 to S9118534, 54.6 to 70.9 mm SL, 03 Feb. 1991, RSV *Aurora Australis*, AAMBER II cruise, Stn 45B, Midwater trawl IYGPT, Prydz Bay, 68°31,08'S, 77°29,3'E, 399-415 m; 8 spm S9111755 to S9111761 and S9111765, (37.7) to 67.3 mm SL, 19 Feb. 1991, RSV *Aurora Australis*, AA91 cruise, Stn 79, otter

trawl, Prydz Bay, 68°58,33'S, 74°23,84'E, 787 m; 1 spm T912860, 77 mm TL, 24 Feb. 1991, RSV *Aurora Australis*, AA91 cruise, Stn 92, otter trawl, Prydz Bay, 66°43,6'S, 71°54,47'E, 676 m.

MNHN collection specimen. - MNHN 1992-271.

Paraliparis terraenovae is the smallest species in the CEAMARC samples. The very low number of pectoral fin rays (8-9 + 2-3 + 2-3, total 13-14), the unusually pointed snout and the radials formula (only two, 1 upper 1 lower, medium to large radials) (Tab. II) allow a quick identification of this species. We include here the first published colour photo of a fresh specimen. It adds two new characteristics to consider from live specimens: a silvery post-ventral part of the head, behind the middle part of eye, to the peritoneum, and a silvery iris. The body colour is pale pink and translucent, with internal organs quite visible.

It appears to be the only clearly pelagic species of the Antarctic *Paraliparis* with frequent catches using pelagic trawls (IYGPT *Umitaka Maru* CEAMARC cruise and *Aurora Australis* AAMBER II cruises). However, it also occurs close to the bottom as shown from catches using beam and otter trawls.

Stein and Andriashev (1990) already proposed a large circumantarctic range for *P. terraenovae*. The present extension to east Antarctica confirms this assumption. The bathymetric range seems limited to depths between about 450 and 875 m from the inner shelf depressions to the Antarctic continental shelf border, with frequent pelagic occurrence over

these depths and offshore (Fig. 24).

Paraliparis terraenovae was reassigned to a new genus, *Edentoliparis*, by Andriashev (1990). But the molecular results (Fig. 3) clearly place the studied specimens within the clade of other *Paraliparis*, and rather support the previous nomenclatural position (see discussion). Therefore, based on the data from these specimens, we suggest that the species should belong to *Paraliparis*.

***Paraliparis valentinae* Andriashev & Neyelov, 1984**

(Fig. 25)

One specimen

RSV 'Aurora Australis', CEAMARC, Terre Adélie and George V Land, beam trawl. - MNHN 2008-2610, 236.3 mm TL, 222.3 mm SL, 16 Jan. 2008, Stn 86, 65°27.7'S, 139°18.5'E, 784-814 m, BOLD: EATF498-10.

MNHN collection specimens. - MNHN 1991-353 and 354.

Paraliparis valentinae is probably one of the largest Antarctic *Paraliparis* species, with sizes up to 240 mm SL (260 mm TL). A large gill slit extending to the middle of the base of upper pectoral rays. No clear distinction in size of the pectoral fin rays ($21 + 4 + 3 = 28$) is noticeable (Fig. 25). High counts in other meristic characters and 4 distinctly large radials occupying the majority of the girdle surface are also diagnostic characters (Tab. II). This species is also easy to recognize when fresh. The general pinkish body colour, the large black eye, the bluish-lilac peritoneum and terminal part of internal body, the reddish terminal end of rays were photographed (Duhamel, 1992).

The circumantarctic distribution is confirmed from all the records (Weddell Sea at 29°W, Duhamel, 1992; East Antarctica at 34°E, Andriashev and Neyelov, 1984 and presently at 139°E). Deep-sea occurrence on external slope of Antarctic shelf at around 1000 m seems a common feature of the records (784-1100 m) (Fig. 26). The species exhibits epibenthic habits but is quite uncommon or only locally abundant.

DISCUSSION

The liparids of the Southern Ocean (oceanographic boundaries exclude the tip of the continental shelf and slope of South America, Southern Australia and New Zealand) is composed of 66 endemic species, under four genera: *Notoliparis*, *Genioliparis*, *Careproctus*, *Paraliparis* (with *Edentoliparis* being presently reassigned to *Paraliparis*), with respectively 2, 1, 27, and 36 species. However the descriptions are based on very few specimens, due to the small size of most of the species, the scarcity of sampling in the Southern Ocean (due to sea ice coverage during a part of the year around the Antarctic coastline or heavy weather: roaring forties to fifties) and the very large range of bathymetric distribution of specimens. All of the oceanographic,

scouting and fishing cruises have collected only about 725 specimens, most of these registered in collections (see Andriashev, 2003). Only three specimens of Antarctic species of *Notoliparis* are known, five specimens of monotypic genus *Genioliparis*, 90 specimens of *Careproctus* (including 15 species known only from their holotypes!) and 623 specimens of *Paraliparis* (with 10 species known only from their holotypes and including 16 specimens of *Edentoliparis*). Therefore, any future survey will provide new information for both the systematics and ecology of the family. The POKER 2006 and CEAMARC cruises can be considered very informative with 90 specimens (13 species from the two main genera). Additional records from Prydz Bay (30 specimens from 3 species) and the southern part of the Kerguelen Plateau (Heard Island) (23 specimens from 2/3 species) also fill the gap for the Eastern Antarctic and subantarctic sector of the Southern Ocean. More specimens are included in the BOLD and would be a valuable addition to any further morphological and molecular study. As many species are known from only a few specimens, and the first molecular studies are only beginning, the discovery of new species is still quite probable, as demonstrated recently with North Pacific Liparids (Steinke *et al.*, 2009).

Caution is needed in interpreting the results of the two present surveys for geographical and bathymetric distributions in the Eastern Antarctic, despite the synoptic protocol. The type of survey (random *versus* regularly spaced stations) differed between the two surveys, as well as the bathymetric range (POKER 2006 investigated shallower waters, 100-1000 m, than CEAMARC, 163-2065 m). The use of various gears for CEAMARC (otter trawls, beam trawls, IYGPT) and only commercial bottom trawl for POKER 2006 also distinguishes these cruises. However, the differences are compensated by the data previously acquired in the Kerguelen area (Duhamel, 1992; Chernova and Duhamel, 2003; Duhamel *et al.*, 2005), which were not available for CEAMARC pioneer exploration of Terre Adélie and George V Land.

The most abundant species of the Kerguelen Plateau seem limited to the slopes of the islands shelves and surrounding banks (*P. operculosus*, *P. neelovi*, *P. copei kerguelensis*), but some others have a larger range (*P. thalassobathyalis*) in geographic distribution. The lack of records for *Careproctus* species nearby the Plateau is probably a result of a lack of investigation of the deep-sea range. Such a situation occurred off the Crozet Islands before a recent deep-sea survey (Duhamel and King, 2007). No species occurs on the Kerguelen Plateau inner shelf. This is a difference with the Antarctic continental shelf where a specific inner shelf species (*P. leobergi*) is present, as recorded by the CEAMARC cruise. The species found off Terre Adélie and George V Land confirms the circumantarctic distribution of both *Paraliparis* and *Careproctus* main species. There is depth segregation between *Paraliparis* and *Careproctus* species, as

the latter are only present off the slope in the deep-sea. An interesting discovery from the results of the CEAMARC cruises is the presence of some *Paraliparis* species (*P. antarcticus*, *P. charcoti*, *P. terranova*) in the depressions of the inner continental shelves, not present in the subantarctic peri-insular shelves, providing the latest information on the habitat of this genus. Again the “pelagisation” of *P. terraenovae* seems the most advanced specialisation of an epibenthic genus. Such beginning of midwater habits seems to be also developed in the subantarctic with *P. thalassobathyalis*. Such specialisation seems to lead to the reduction in the total number of radii for the pectoral girdle (2G + 0 + 0 for *P. thalassobathyalis* and 1 + 0 + 0 + 1 for *P. terraenovae*). From both studied synoptic surveys, abundance of the species begins to be evaluated with dominance of *P. antarcticus* on the Antarctic continental shelf (in the inner depressions) and *P. operculosus* on the Kerguelen Plateau.

From a molecular taxonomic point of view, the topologies of both the Bayesian inference tree and the maximum parsimony tree hint at the non-monophyly of two genera: *Liparis*, and very probably *Careproctus*. Several other genera are included in *Paraliparis* and *Careproctus*, and so their status will need to be reassessed too. Most clades on the Bayesian inference tree include specimens from both the Northern and the Southern Hemispheres, and only two clades are geographically relatively homogeneous. Moreover, three specimens identified as *Careproctus georgianus* (TZFPA097 06, TZFPA096 06 and GBGC7223 09) with a low divergence among their sequences have been collected in distant areas (North Pacific and Scotia Sea). These surprising results, if the species identification is confirmed, hint at either multiple dispersal events between very distant areas in this group, which is at odds with our knowledge of their dispersal capabilities, or a distribution much larger than currently known. With the present specimen sampling and lack of nuclear markers, it is not possible to choose between these hypotheses, nor to propose leads on the directionality of the exchanges. A larger study including nuclear markers for the same specimens is under way to corroborate these results.

For molecular identification, the use of the COI barcode appears promising, with a few caveats. For our sampling, the topology of the molecular results (clustering by species) is highly correlated with the morphological identification, so the position on the trees (whether distance or Bayesian inference) can be used for identification. This will however have to be controlled with variable nuclear markers. This clear clustering on the molecular tree has already allowed us to corroborate the identification of the smallest specimens of several species (*P. leobergi*, *P. charcoti*, *P. mawsoni*) for which meristic values were difficult to obtain and assess from x-rays. Molecular identification could be very useful in the future surveys, provided a reliable reference dataset is made available (but see Ward *et al.*, 2009).

When examining the COI alignment, molecular synapomorphies can be detected for all species. Also, considering the tree branch-by-branch, maximal intra-specific variability is always smaller than the minimal divergence from the closest species. However, the level of divergence within and between species is variable across the branches of the tree. Some pairs of species have a divergence below 1%, while some others have an intra-specific variability above this value. It is better to exercise caution for this group, and not use a cut-off value for identification, but rather the position on the tree. This also hinders the use of divergence values to identify potential new species in this group at the lower divergence values. More investigation is needed, especially using nuclear markers.

The availability of the collection registered specimens allowed us to confirm the validity of species, often known only from their holotypes. This is supported by the molecular results, and 18% of the Southern Ocean liparid species are included in the present work. Some morphological characteristics including internal anatomy (pectoral girdles) and useful colour patterns are described here for the first time and reinforce the interest of such surveys. Moreover, the ecological data assembled from the new specimens will be useful for future studies of preferential habitats of these species.

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